RI

RESEARCHES ON THE MOTION OF THE MOON

By SIMON NEWCOMB.

PART II.

THE MEAN MOTION OF THE MOON AND OTHER ASTRONOMICAL ELEMENTS DERIVED FROM OBSERVATIONS OF ECLIPSES AND OCCULTATIONS EXTENDING FROM THE PERIOD OF THE BABYLONIANS UNTIL A. D. 1908.

PREFATORY NOTE.

The present work is the last of a series of papers on the Moon by Professor Newcomb, extending over a period of 40 years. It was completed during his last illness and the copy for the printer was finished only a month before his death. In putting this work through the press Dr. F. E. Ross, who was associated with Professor Newcomb throughout its entire preparation, has been freely consulted with the view of overcoming as far as possible the disadvantage in publishing such a work without the assistance of the author. It would doubtless have been changed in many minor points at least if it had been possible for him to have seen the proof.

The arduous work of proof reading has been performed by Mr. H. G. Hodgkins and Mr. Arthur Snow of this office.

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NAUTICAL ALMANAC OFFICE, *May, 1912.*

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PREFACE.

More than 30 years have elapsed since the publication of the author's Researches on the Motion of the Moon as an appendix to the Washington Observations for 1875. These researches were incomplete in being devoted almost entirely to observations before 1750. In the present work, which is a continuation of the former one, the discussion is brought down to the present time. As thus completed, the whole work may be described as a discussion of ancient and mediæval eclipses of the sun and moon, and of occultations of stars by the moon observed from 1627 to the present time, with the general purpose of studying those fluctuations in the moon's motion which are not represented by existing theory. The work also includes a determination of some of the fundamental astronomical elements from the occultations, which may prove more accurate than any afforded by the older methods.

The most important fact brought out by this and other researches of the author on this subject, and by a comparison with the theoretical researches of other investigators, especially of Prof. Ernest W. Brown, is that the moon's mean motion is subject to fluctuations which are not only unrepresented by existing theory, but for which it seems difficult to assign any sufficient physical cause. That fluctuations exist has been known from the time of Laplace, but the question whether they could be represented by gravitational theory was long a mooted one. Hansen supposed that the inequalities were completely explained by his discovery of two terms of long period, due to the action of Venus on the moon. His tables of the moon, which were published in 1857, embodied these inequalities, and were supposed to represent both ancient and modern observations in a satisfactory way.

The evidence adduced by Hansen for the supposed agreement was limited to the period 1750 to 1855. During this period observations were so well represented by the tables that Hansen's view seemed well established. But from 1862 to 1869 the tables deviated from observation in such an unexpected way that the author undertook a comparison of their results with observations before 1750. The only available observations which seemed worth using were occultations of stars by the moon, and solar eclipses. He found that the deviation from observation was unexpectedly wide, showing large fluctuations in the moon's mean motion not represented by Hansen's tables. As the most recent observations showed that the moon was falling behind its tabular place at a rate of more than half a second annually, the author entered upon two lines of investigation: one, to find whether any unknown inequalities of long period could be derived from theory; the other, what inequalities were shown to exist by the totality of available observations. To prosecute this last inquiry it became necessary to work up all the earlier available observations, and to ascertain what light would be thrown on the subject by ancient records of solar and lunar eclipses. For this purpose a search was made into the manuscript records of several European observatories, especially that of Paris, with a view of finding unpublished observations of occultations. It was found that such observations had been made from 1672 until about 1740 of such precision that by careful discussion it was possible to trace out the mean motion of the moon in longitude with a precision fairly comparable with that reached by meridian observations during the first half of the nineteenth century.

The determination of the secular acceleration being a necessary part of the work, a discussion of ancient solar eclipses was also undertaken. Great stress having been laid on real or supposed records of such eclipses found in the works of ancient historians, the question arose as to their availability for the purpose in question. As this subject is rediscussed in the present work, it will suffice to remark here that the records in question failed to inspire the author with any confidence that reliable conclusions could be derived from them. It appeared that the only ancient data that could be safely used for the determination of the secular acceleration were the eclipses of the moon recorded by Ptolemy in the Almagest, and a number of solar and lunar eclipses observed by Arabian astronomers during the ninth and tenth centuries.

Combining these with the most recent observations, it was found that the apparent secular acceleration was little more than half that which had generally been adopted, and little greater than that derived from modern theory. This result implied a smaller tidal retardation of the earth's rotation than had been supposed probable. The subject thus opened up has been widely discussed from various points of view by contemporary astronomers. Their conclusions are, so far as it seems necessary to the purpose of the present work, reviewed and discussed in the following chapters.

One conclusion of the former work was that at least one fluctuation having a period of nearly three centuries, and a coefficient exceeding 10″, still existed in the moon's mean motion, which was not explained by theory. The author's efforts to find a term in the theory which would represent this fluctuation have appeared in two memoirs. The first was published in 1896 as Volume V, Part III, of Astronomical Papers of the American Ephemeris; the other was published by the Carnegie Institution as No. 72 of its publications. Of these works it is only necessary to say that no such term has been found, and that it is difficult to see any possibility that it can exist in gravitational theory. Yet more complete and exhaustive is the recent work of Brown, which seems to establish the nonexistence of such a term.

The first step in the explanation of an anomalous phenomenon is a precise knowledge of its character. The main purpose of the present work is, therefore, to show with all the precision of which the observations admit, what unexplained fluctuations the mean motion of the moon has actually undergone.

The mass of material on which the work is based is so large, and the computations have proved so prolix and varied, that a full presentation of the processes would be difficult for any student of the subject to follow. It has therefore been deemed best to limit the published work to those steps and results which will best facilitate its criticism, revision, and use by the future investigator. It can scarcely be supposed that anyone, even should he reconstruct the entire work, would repeat the author's study of each individual observation. A systematic and complete list of the original sources is therefore not given, and the published steps of computation have been reduced to those best adapted to test their correctness and facilitate such revision as may be found necessary. An attempt has been made to so plan and arrange the chapters that the student of the work shall find it as easy as possible to trace out and revise any of its processes for himself in his own way. The analytic table of contents has been arranged with this end in view. To avoid the necessity of going over this table in each special case, it may be remarked that matters relating to the purpose of the work and the reasons for the form which it has assumed will generally be found in the introductory chapter under the appropriate head for each. The subsequent chapters are so planned and arranged that each shall be, so far as is possible, complete in itself. Detailed contents of each will be found at its beginning whenever the work of examination would thus be facilitated. The author emphasizes this policy owing to the difficulty he often finds in looking up special points in the works of his fellow investigators, not to say his own. It is too often necessary to go over a large portion of a work to find some special point, such as the meaning of a symbol, the character of a result, or the nature of a process.

It is expected that the computations will all be arranged, collected, and preserved at the Naval Observatory in the archives of the Nautical Almanac Office in such form that the student of the subject who wishes to see the original computations can readily find those pertaining to any of the chapters. For the most part the papers are divided into six classes, which were originally kept in as many cases designed for the purpose. These classes are:

(A) Matters pertaining to the reduction of the observations so as to obtain the local and Greenwich mean time of each. This class is largely composed of copies of observations either supplied by the observers or obtained from printed data; of the time reductions for the older observations; matters pertaining to the geographical positions of the stations; and miscellaneous information generally as to the work.

(B) The computations and copies of tabular geocentric positions of the moon. Most of these tabular positions were computed in bound books on ruled and printed forms, but many were made on forms prepared by the computer.

(C) Matters pertaining to the positions of the occulted stars; especially their longitudes and latitudes.

(D) Reductions for parallax and computations of the differential coefficients, both of which are made on the same forms.

(E) Tabular summary of the reductions of class A.

(F) Final revision of the coefficients, solution of the equations of condition, and discussion of the results generally.

As a general rule, computations pertaining to the corrections have been placed in the same class with those of the quantities corrected. There is a large and quite miscellaneous mass of computations for correcting the parallaxes, observed time, etc. In the final computations the various parallactic and miscellaneous corrections were computed together and the results combined.

As the author has already intimated, he can not conceive that it will be worth while for anyone to attempt the revision or even the examination of this great mass of computations in detail. In the reconstruction of the work most of the numbers, especially those pertaining to the equations of condition, can be used without revision. The corrections to the tabular longitudes, and parallactic corrections, if the work is revised, should be recomputed *ab initio*.

The great number of computers employed on the work from time to time and the period of 30 years through which it extended, during which supposedly improved values of the astronomical elements became available, have resulted in a great portion of the correctional work being done several times over with continually improved numbers. The author does not disguise the inevitable advantage which the future investigator of the subject will enjoy in being able to start with definitive provisional data and carry it through every branch of the work on a uniform system.

As to the history of the work itself, it may be remarked that at the time of publishing the former researches the author had in view the speedy continuance of the discussion from 1750 till the present time. The great mass of the occultations observed during this period were worked up under his direction in the office of the Nautical Almanac during the years 1878–1888. Owing to the necessity of completing the planetary tables, the work had then to be laid aside. The official retirement of the author from active service in 1897 threw difficulties in the way of its continuance as an official work. In 1903, through the agency of the Carnegie Institution, an arrangement was made with the Navy Department for its continuance under the auspices of that institution, to which the unfinished work was turned over from the archives of the Nautical Almanac Office and of the Naval Observatory.

During the 15 years which had elapsed since the cessation of the work, much better determinations of the fundamental elements of reduction had become available, and it was found that important corrections were sometimes necessary in consequence. The introduction of these corrections was no easy matter, and was made more laborious from the fact that, even in the original work, some of the elements had been changed as supposedly improved values became available. Most important among these are the constants pertaining to the ellipticity of the earth and the parallax of the moon. Of the difficulties incident to the frequent changes of computers, to the preparation of formulæ for their use, and to the avoidance of accidental and systematic errors of computation, it is unnecessary to speak. It will suffice to remark that the details of the work have been so arranged as to make the discovery of any errors thus arising and still uncorrected as easy as possible.

Acknowledgment is due the Carnegie Institution for the very liberal way in which it has made the grants necessary for the employment of computers, and for clerical assistance in the work. On the official side it is worthy of record that the great mass of the earlier computations was made by young officers of the Navy, whose training well fitted them for such work.

In the completion of the work the author takes pleasure in acknowledging the very important services rendered by Dr. Frank E. Ross, who has acted both as computer and superintendent of computations, and whose care and efficiency in the performance of these duties have contributed greatly to facilitate the completion of the work and insure its correctness. As the author is unable to revise the proof himself, the task of seeing the work through the press must devolve upon others, probably on Dr. Ross.

The author's thanks are also due to Prof. E. W. Brown, who has made a thorough and critical examination of the entire work before it was passed for the press, resulting in a number of minor emendations.

WASHINGTON, JUNE 15, 1909.

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Bibliography.

The following is a list, perhaps incomplete, of the author's writings on the lunar theory, especially the development of the enigmatical fluctuations in the moon's mean motion. He would have been glad to make a complete bibliography by all the writers on the subject, but he believes that scarcely anyone besides himself has written at length on this particular branch of the lunar theory. Such bibliography should include the investigations of Airy, especially his reductions and discussions of the Greenwich lunar observations from 1753 until 1850. The original material for this work is found in the publications of the Royal Observatory. Several of Airy's papers discussing the results are found in the Philosophical Transactions and in the Memoirs and the Monthly Notices of the Royal Astronomical Society.

The author first called attention to the inconsistencies between theory and observation about the year 1869. Since then his papers on the subject have been the following:

1. Considerations on the apparent inequalities of long period in the mean motion of the moon. American Journal of Science, Series II, Vol. L, pp. 183–194, September, 1870. (Read before the National Academy, April, 1870.)
2. On a hitherto unnoticed apparent inequality in the longitude of the moon. Monthly Notices, R. A. S., Vol. XXXVI, pp. 358–361, June, 1876.
3. Papers published by the Commission on the Transit of Venus. (This is the first of the author's series of researches on the elements of the moon's motion. That it appears in connection with the transit of Venus arises from its being undertaken in order to correct the tabular longitude of the moon for all known sources of error in order to determine the longitudes of the stations occupied for the observations of the transit.)
4. Note on the new inequalities in the moon's longitude, pointed out by Mr. Neison. Monthly Notices, R. A. S., Vol. XXXVII, pp. 428–430, June, 1877.
5. On the mean motion of the moon. American Journal of Science, Series III, Vol. XIV, pp. 401–410, November, 1877. (This is an abstract of the next paper.) Also a summary in the English Mechanic, Vol. XXVI, p. 400, January, 1878.
6. Researches on the motion of the moon made at the United States Naval Observatory, Washington. Part I: Reduction and discussion of observations of the moon before 1750. Washington, 1878. (Appendix 2, Washington Observations, 1875.)
7. Note on the correction to the mean longitude of Hansen's lunar tables. Monthly Notices, R. A. S., Vol. XL, pp. 81–82, December, 1879.
8. A transformation of Hansen's lunar theory compared with the theory of Delaunay, by Simon Newcomb, aided by John Meier. Astronomical Papers, Vol. I, Part II., pp. 57–107, 1882.
9. The apparent inequality in the mean motion of the moon. Letter dated Neuchatel, Switzerland, July 11, 1883. The Observatory, London, Vol. VI, pp. 243–244, August, 1883.
10. Remarks on published corrections to Hansen's Lunar Tables. Astronomische Nachrichten, Bd. 107, s. 269–270, December 4, 1883.

11. Theory of the inequalities in the motion of the moon produced by the action of the planets. Astronomical Papers, Vol. V, Part III, pp. 97–295, 1894. (The work developed in this paper was actually carried through more than 20 years before its publication, which was delayed in the hope that the author would be able to put the method into a satisfactory practical form. It has since been proved that as a general method it can not be made practical. But many of its formulæ and developments seem to be of use in the lunar theory; at least such is the opinion professed by Prof. E. W. Brown.)
12. On the use of statements of ancient solar eclipses for correcting the elements of the moon's motion, with special reference to Professor Ginzel's "Specieller Kanon der Finsternisse." Astronomische Nachrichten, Bd. 154, s. 197–202, January 25, 1901. Dated Washington, December 5, 1900.
13. On the desirableness of a reinvestigation of the problems growing out of the mean motion of the moon. Monthly Notices, R. A. S., Vol. LXIII, 316–324, March, 1903. (This paper comprises a general résumé of the observations and investigations which show the reality of unexplained fluctuations of remarkable magnitude in the mean motion of the moon. It is believed that it was due to the appearance of this paper that the subject of inequalities produced by the action of the planets on the moon was proposed as an Adams prize essay. This prize was awarded to Prof. E. W. Brown Feb. 8, 1907.)
14. Investigation of inequalities in the motion of the moon produced by the action of the planets. Publication No. 72 of the Carnegie Institution of Washington, dated June, 1907. Hereafter referred to as "Action II."
15. La Théorie du Mouvement de la Lune, son histoire et son état actuel. Address before the International Congress of Mathematicians in Rome, April, 1908. Atti del IV Congresso Internazionale dei Matematici, Roma, 6–11 Aprile, 1908, Vol. I, pp. 135–143. (This is a discussion of the whole subject more complete than that published in 1903.)
16. Fluctuations in the moon's mean motion. Monthly Notices, R. A. S., Vol. LXIX, pp. 164–169, January, 1909. Dated Washington, December 11, 1908. (This is an abstract of the present work.)
17. Comparison of ancient eclipses of the sun with modern elements of the moon's motion. Monthly Notices, R. A. S., Vol. LXIX, pp. 460–467, March, 1909. (The basis of this paper is also formed by the results of the present work. Its purpose is to decide whether the ancient eclipses can be used for correcting the lunar elements, a point on which the author has generally differed from his fellow investigators.)

RESEARCHES ON THE MOTION OF THE MOON, PART II.

CHAPTER I.

INTRODUCTION.

1. We begin by presenting such statements of the purpose, methods, and contents of the present work as shall facilitate the mastery and criticism of its processes and conclusions. Taken in connection with the "Researches" of 1878, of which it is a continuation, the purpose of the work may be defined as primarily a determination of the moon's mean motion and its fluctuations of long period, by means of all available material not previously worked up by others. Practically the material is limited to eclipses and occultations. The reason for omitting meridian observations is twofold. The Greenwich observations of the last half century have been very fully discussed and their results worked out by Mr. Cowell, under the auspices of the Royal Observatory itself. The results have appeared in recent publications of the Royal Astronomical Society. The older Greenwich observations require to be reduced with modern data before they can be of much use. They are therefore practically unavailable at present.

The large difference known to exist between the personal equation in observing the limb of the sun or moon and a star renders meridian observations less suitable than occultations for detecting changes in the moon's mean motion. The result of this difference is that during periods of several consecutive years the mean longitude of the moon derived from meridian observations may be appreciably in error. Observations of occultations are comparatively free from this source of error, and are therefore most suitable for determining fluctuations of long period in the mean motion. Moreover, as this class of observations extends back more than 80 years before meridian observations are available, they afford a series of fairly uniform results extending through more than 230 years.

On the other hand, inequalities of short period can as a general rule be better determined from the meridian observations than from occultations. In this statement must be included the determination of the eccentricity and of the longitude of the perigee, taking for the latter its value at any recent epoch. But the motion of the perigee can not thus be well determined until the Greenwich meridian observations from 1750 to 1830 or 1840 are better reduced and compared with the tables than they have yet been. Observations of occultations being available since 1625, they are now essential in the determination, but may still lose importance when the data of meridian observations are complete. In the work already alluded to, Mr. Cowell has discussed the Greenwich observations of the last half century so completely that his results for the inequalities of short period seem to be definitive so far as present requirements are concerned. They still remain to be compared with Brown's theoretical determinations. Should any discrepancy be found too large to be accounted for by known causes, additional investigation may be required.

An exception to this is the parallactic inequality. Great interest attaches to this inequality because its accurate determination affords one of the most precise methods of determining the solar parallax. In this determination the numerical divisor of the inequality is nearly 15, so that, possible theoretical uncertainty aside, the error of the parallax will be little more than one-fifteenth that of the inequality. It follows that if the latter can be determined from observations within the limits $\pm 0''.15$, the solar parallax will be determined within $\pm 0''.01$. But, in the case of the meridian observations, it is impossible to free the true value of the inequality from systematic errors varying with the position of the moon relative to the sun. From this cause it can hardly be expected that any such determination will be accurate to the degree mentioned. But, for the most part, observations of occultations are free from at least the larger part of this systematic error. The difficulty of dealing with them is, however, such that we can not in advance define the degree of precision, but we have good reason to believe that the result will be markedly better than that which can be derived from meridian observations.

2. The preceding remarks apply to the inequalities of the moon's motion in right ascension or longitude. In the case of the declination, meridian observations of the ordinary class are subject to a serious drawback of that troublesome character that may be called semi-systematic. This arises from the motion of the moon in declination. Although we habitually speak and think of an observer as observing the image of a star, or placing the thread of his instrument tangent to the limb of the moon at a definite moment of time, or when the object is in a definite position, such is practically never the case. Time is required for all mental operations, and the setting of a thread can never be the work of a moment. Practically it requires the work of a number of seconds, and the time will be longer the worse the image. In the case of a star or planet, or even of the sun, this is no drawback, because the accurate setting remains practically unchanged during a period of a number of seconds, and the skilled observer can arrange his setting to correspond to some mean and well determined moment. But, in the case of the moon, unless near the points of maximum or minimum declination, the motion in declination while the observer is deciding upon the tangency may be appreciable. It will commonly amount to an entire second near the equator. Under such circumstances personal error of a systematic character is unavoidable. The system of setting the thread in a fixed position and observing the time of transit of the limb over it might do away with the error in great part. But I do not think that this device has ever been adopted. Observations of occultations are completely free from this source of error and are therefore best adapted to determine the node and inclination of the lunar orbit.

3. A weighty consideration which offered to the author a strong inducement to undertake and carry through a work so onerous is that occultations afford a method of determining certain astronomical elements pertaining to the motion of the earth with possibly greater precision than does any other method. Making abstraction of the inequality in the moon's latitude arising from the oblateness of the earth, the mean orbit of the moon coincides with the ecliptic. The determination of the position of the latter in the usual direct way by observations of the sun is subject to large systematic errors arising from numerous causes, known and unknown, incident to diurnal changes of temperature. In reducing an observation of the sun the refraction is determined from the external temperature in the same way as in the case of a star at night. But owing to the very different law of temperature in the very different strata of air by day and by night, the same formulæ can not hold for the two cases, and the difference continually increases as we pass from the zenith to the horizon. In these different laws of temperature must be included the difference in the temperature inside and outside the observing room, and even inside and outside the tube of the instrument—we might say even the difference between the lower side and the upper side of the column of air in the tube itself, which is found to cause a quite measurable refraction within the tube. To this cause must be added others, the effect of which can not be determined, due to the action of the sun on the instrument and to the systematic difference, never admitting of determination, between the personal equation for the sun and for a star. An example of the uncertainty thus arising is seen in the very discordant results for the position of the ecliptic as determined at

Greenwich year after year, where the constancy of the conditions is such that we should suppose the results to be nearly the same, how much soever they might be affected by systematic error.

Observations of occultations are practically free from this source of systematic error. It is quite true that the position of the ecliptic determined from them will be affected by whatever corresponding systematic error may affect the positions of the stars. But, from the general uniformity of the conditions under which star determinations are made, the systematic errors are much less than those liable to affect observations of the sun. For this reason the present work includes the determination from occultations not only of the lunar node and inclination, but the position and motion of the equinox, or the common correction to the absolute right ascension of the stars, and the secular variation of the obliquity of the ecliptic. The obliquity itself can not be reliably determined owing to the uncertainty of the effect of the earth's oblateness.

In setting forth the advantages of occultations for the determinations in question, the writer does not desire to ignore a very serious drawback the importance of which can not be estimated except by a careful study of the finished work. This is the large probable error of the best observations as shown by the discordance between observations at different places and times. The main source of this error is probably to be found in the inequalities of the lunar surface. So far as purely fortuitous this error may be regarded as accidental and therefore admitting of almost complete elimination by increasing the number of observations. In the present work this number is so great that, theoretically, the result should be satisfactory.

But a study of the distribution of the residual errors in magnitude shows that, in common with most astronomical observations, this distribution does not follow the normal law of error, both large and small errors being more frequent than they should be if the law were followed. This feature is doubtless largely due to defects in the practice of observers. Without great care the disappearance of a star in the glare surrounding the moon's bright limb is liable to be mistaken for an actual occultation. We must therefore expect an undue number of errors of the same sign in this class of occultations. In the case of emersions, even at the dark limb, the observer may fail to catch the star at its actual instantaneous reappearance, and it may happen that the only method of detecting an error may be by the discordance of the result. It must be admitted that a conscientious and careful observer ought rarely to be at fault in such case without knowing it; how far this holds can be determined only by a study of results.

It is a curious psychological fact, which I have observed through the whole series of observations, that when an observer is conscious of having noted an immersion too soon, or an emersion too late, his estimate of the error may safely be multiplied many times, perhaps ten times on the average.

A seemingly fair method of eliminating all this class of errors is by having an occultation at one and the same station observed independently by several observers, as is generally done at Greenwich. Yet, a comparison of final results may show that all systematic errors are not thus avoided. Unfortunately, there are few other observatories than Greenwich at which occultations are habitually noted by more than one observer.

General Arrangement of the Work.

4. It seems essential to the usefulness of the work to the future investigator that it should be so arranged as to facilitate its criticism and correction. One method of doing this is to present as fully as possible the various steps of computation.

In publishing the former work, the tabular data and steps of computation were given with some fullness in the form of tabular exhibits. In the original plan of the present work it was intended to adopt the same policy, but after some consideration the author judged that the publication of so large a mass of matter as the separate data for some 4,000 occultations would render cumbrous the study of the work, and that scarcely any case would be likely to rise in which a future investigator would deem it worth while to repeat the reduction of any one occultation out of so large a mass.

The repeated corrections which had to be made from time to time in the work as constants were changed, improved methods devised, and correction after correction applied, must all result in increasing the probable error of the constant terms in the equations. If, therefore, the work is ultimately to be revised and reconstructed by the future investigator, his best course will not be to attempt its repetition, but to proceed *de novo* so far as the absolute terms of the equations of condition are concerned. This is especially true with the numerous corrections of all kinds which have to be applied to Hansen's tables. It is not meant by this statement that these tables can not be the basis of a revision, and that new provisional ones should be substituted. The view taken by the author is that it will be advantageous to substitute a new system of corrections to Hansen's tables for the one he has used, to decide upon the best constants of the geoid, and then to repeat the computation of the absolute terms of the equations. The labor of doing this, if carried through systematically, will be much less than that of revising the whole work.

These remarks apply only to the absolute terms of the equations. The coefficients of the conditional equations are, the author believes, sufficiently accurate for all future purposes, occasional accidental errors aside. He adds that it will not be necessary even to repeat the computation of the coefficients of the normal equations, especially as these have been so arranged as to facilitate any new combination that may be desirable.

CHAPTER II.

ADOPTED METHODS AND FORMULÆ OF REDUCTION.

5. The essential features of the process employed by the author to derive an equation of condition from an observed occultation are to be mentioned. What the observation gives is, that at a certain moment of time, the apparent angular distance between the moon's center and the position of the occulted star is equal to the moon's apparent angular semidiameter. The processes of utilizing such an observation for determining corrections to the elements of the moon's motion are the following:

For the observed Greenwich mean time the tabular apparent position of the moon's center, as seen from the point of observation, is to be computed from the tabular data. The apparent position of the star being also computed, the tabular distance between the latter and the center of the moon is determined. The comparison of this distance with the apparent semidiameter of the moon gives the error of the tabular place projected upon the line joining the center of the moon and the star. Expressing this error in terms of errors of the various elements, an equation of correction is formed.

The formulæ and methods of computation are derived in the Researches of 1878, and are recapitulated in the present paper in their proper connection so far as is necessary for the understanding of the numerical processes. The principal steps of computation are the following:

(1) Computation of the geocentric spherical coordinates of the moon for the moment of observation expressed in Greenwich mean time. These are made originally from Hansen's tables or, since 1862, from the ephemeris given in the Nautical Almanac. (Generally from 1847 from the Nautical Almanac computations.)

(2) Computation of the corresponding geocentric coordinates of the observer for the same moment.

(3) With these relative coordinates of the moon and of the observer, the tabular apparent spherical coordinates of the former as seen by the latter are computed. Also the moon's semidiameter.

(4) Computation of the apparent position of the star. Before 1862 the coordinates of the moon and star are generally referred to the ecliptic; from and after that year to the equator.

(5) Computation from these apparent coordinates of the tabular distance between the center of the moon and the star.

(6) Computation of the differential coefficients by which the correction of the distance is expressed in terms of corrections to the various elements involved.

Reduction Using Ecliptic Coordinates.

For the period before 1862 it was found convenient in computing the moon's apparent position to reduce the coordinates of the observer upon the earth to the ecliptic, rather than to reduce the moon's ecliptic coordinates to the equator. This required that the position of the stars should be reduced from right ascension and declination to longitude and latitude. The labor of this transformation is partly compensated by the greater simplicity of the reductions to remote epochs, and to apparent place, when ecliptical coordinates are used. As occultations of the same star are often observed several times, the excess of labor is thus divided. It may be added that the computation of the coefficients for correcting the lunar elements is also simpler with ecliptical coordinates.

NOTE.—In the completion of the work at the Carnegie Institution use was made almost exclusively of the equatorial coordinates from Hansen's tables which are found in an appendix in the Monthly Notices, R. A. S., Vol. L.

The formulæ used in the reductions up to 1862 are derived with some fullness in the Researches of 1878. For convenience of reference they are here quoted:

6. *Apparent place of the moon.*—Put

$r, l, b,$ the geocentric radius-vector, longitude, and latitude of the moon;
$\rho, \lambda, \beta,$ the corresponding coordinates of the observer;
$r', l', b',$ the corresponding coordinates of the moon as seen by the observer;
$R=\frac{r'}{r};$
$\pi,$ the moon's equatorial horizontal parallax;
$\varepsilon,$ the obliquity of the ecliptic.

The values of λ and β are obtained from the observer's geocentric latitude and his local sidereal time by changing the right ascension and declination of his geocentric zenith into ecliptic longitude and latitude. Putting

φ', the observer's geocentric latitude;
τ, his sidereal time expressed in arc;

we compute u and k' from the formulæ

$$k' \sin u=\rho \sin \varphi',$$
$$k' \cos u=\rho \cos \varphi' \sin \tau.$$

Then $\rho \cos \beta$, $\rho \sin \beta$, and λ are given by

$$\begin{aligned}\rho \cos \beta \cos \lambda&=\rho \cos \varphi' \cos \tau,\\ \rho \cos \beta \sin \lambda&=k' \cos (u-\varepsilon)=\rho \cos \varphi' \cos \varepsilon \sin \tau+\rho \sin \varphi' \sin \varepsilon,\\ \rho \sin \beta \quad&=k' \sin (u-\varepsilon)=\rho \sin \varphi' \cos \varepsilon-\rho \cos \varphi' \sin \varepsilon \sin \tau.\end{aligned}$$

In the Researches of 1878 Bessel's spheroid was adopted in the reductions for parallax. This series terminated with the year 1747. Afterwards when the work of reducing the observations since 1750 was undertaken, Clarke's determination of the figure of the earth had been published, and being supposed to supersede Bessel's, was temporarily adopted. A general revision of the constant was made by Listing, whose concluded result was[a]

$$\text{Compression}=1\div 288.48,$$

which was also employed. Thus three values of the compression were adopted in the preliminary work.

In 1903, when the revision and completion of the work was undertaken, it was found that the derivation of the compression from geodetic measures as made by Clarke, and presumably by Listing, was unreliable, owing to the irregularities in the direction of gravity in various regions of the earth, and that Bessel's value which rested on pendulum observations was probably better than the others. The value 1÷298.26 was communicated in writing by Professor Helmert as the most probable found up to 1903, and was therefore adopted as that to which all the results were to be reduced.

At the present time, 1908, the author would not be surprised should it ultimately be found that, after all, the Clarke value best expresses the actual compression of the geoid.

Having thus found the apparent coordinates of the observer, those of the moon may be derived by the equations:

$$\begin{aligned}R \cos b' \cos (l'-l)&=\cos b-\rho \cos \beta \sin \pi \cos (l-\lambda),\\ R \cos b' \sin (l'-l)&=\rho \cos \beta \sin \pi \sin (l-\lambda),\\ R \sin b' \quad&=\sin b-\rho \sin \beta \sin \pi.\end{aligned}$$

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[a] Neue geometrische und dynamische Constanten des Erdkörpers. Astronomische Nachrichten, Bd. 93, S. 318.

Knowing R, b', $l'-l$, and thence l', the apparent semidiameter of the moon, s', is found from the equation

$$\sin s' = \frac{k \sin \pi}{R}, \tag{1}$$

k being the ratio of the diameter of the moon to that of the earth. The semidiameter, s', is so small that we may suppose it equal to its sine, making the equation for its determination, in seconds,

$$s' = \frac{[5.31443]\, k \sin \pi}{R}. \tag{2}$$

The numerical value of k depends upon the adopted constant of lunar parallax, as well as upon the semidiameter of the moon. In the present work we have used

$$s_0 = 932''.58.$$

This with Hansen's constant of parallax gives

$$[5.31443]\; k = [4.74982].$$

But if, before the computation, we increase Hansen's parallax by 0''.40, the logarithm is 4.74977.

The value of k adopted in the original work was that of Oudemans, 0.27264. This gave

$$\left.\begin{aligned} \log k &= 9.43559, \\ s' &= \frac{[4.75002]\,\sin \pi}{R}, \end{aligned}\right\} \tag{3}$$

the parallax being Hansen's.

7. *Apparent place of the star.*—In the original work published in 1878, and in the continuation carried on during the next few years, the right ascensions and declinations of the stars were reduced to the ecliptic with Hansen's obliquity, and the reduction to the equinox of observation was made with the Struve-Peters precession. In the revised work begun in 1903, the positions of the occulted stars were mostly taken from the Catalogue of Standard Stars of 1897, and the Catalogue of Zodiacal Stars published by the office of the American Ephemeris in 1905. The positions for 1900 were reduced to the ecliptic, using the new value of the obliquity:

$$\epsilon = 23^\circ\ 27'\ 8''.26.$$

For the sake of convenient comparison with the older work, the ecliptical coordinates were then reduced to 1850.0, as the standard epoch.

We used the notation

L, the longitude of the star;

B, its latitude.

The precessional motions and the formulæ of reduction to apparent place are approximately those of the author as developed in his Compendium of Spherical Astronomy, §149. They are as follows, unity of time being the star century and the epoch 1850.0:

$$\left.\begin{aligned} \frac{dL}{dt} &= 5024''.53 + \mu_1 - 47''.14 \tan B \cos (L + 6^\circ\ 30'), \\ \frac{d^2L}{dt^2} &= 2''.23 + 0''.40 \tan B \sin (L + 16^\circ), \\ \frac{dB}{dt} &= 47''.14 \sin (L + 6^\circ\ 30') + \mu_2, \\ \frac{d^2B}{dt^2} &= 0''.40 \cos (L + 16^\circ). \end{aligned}\right\} \tag{4}$$

Reduction for aberration:

$$\left.\begin{aligned}\Delta L&=-20''.50\cos(\odot-L)\sec B,\\ \Delta B&=-20''.50\sin(\odot-L)\sin B,\end{aligned}\right\}\qquad(5)$$

$\odot$ being the sun's true longitude.

Nutation has been omitted in computing the places both of the moon and the star.

8. *Distance of centers of the moon and star.*—Having found by the preceding methods,

l', b', s', the apparent longitude, latitude, and semidiameter of the moon;
L, B, the longitude and latitude of the star;

the distance of centers, D, and the angle of position, m, of the line joining the centers are given by the equations

$$\left.\begin{aligned}D\sin m&=(l'-L)\cos\tfrac{1}{2}(b'+B),\\ D\cos m&=b'-B.\end{aligned}\right\}\qquad(6)$$

These expressions are not rigorous, but the error is of no importance, because the angle m is never observed with such accuracy as to be used as a datum for correcting the moon's place, while the error in D is so small as to be entirely unimportant.

Reduction Using Equatorial Coordinates.

9. From the beginning of 1862 the right ascensions and declinations of the moon given in the hourly ephemeris of the Nautical Almanac were used in the reductions. The general plan of the reduction corresponded to that adopted in the case of the longitude. From the geocentric place of the moon as taken from the ephemeris was computed the apparent place of the center as seen by the observer, and the apparent semidiameter. The original reductions were made in the following way. Put

α, δ, the moon's geocentric R. A. and Decl.;
α', δ', its apparent R. A. and Decl. as seen by the observer;
H, its west geocentric hour-angle;
ρ, the radius of the earth at the point of observation;
φ', the geocentric latitude.

Compute

$$\left.\begin{aligned}p&=\rho\cos\varphi'\sin\pi,\\ q&=\rho\sin\varphi'\sin\pi.\end{aligned}\right\}\qquad(7)$$

The apparent position, the factor R, and the semidiameter were then computed from the equations

$$\left.\begin{aligned}R\cos\delta'\sin(\alpha'-\alpha)&=-p\sin H,\\ R\cos\delta'\cos(\alpha'-\alpha)&=\cos\delta-p\cos H,\\ R\sin\delta'&=\sin\delta-q,\end{aligned}\right\}\qquad(8)$$

$$s'=\frac{[4.75002]\sin\pi}{R},$$

or, with the semidiameter and parallax as finally adopted,

$$s'=\frac{[4.74977]\sin\pi}{R}.$$

To find the distance and position angle between the moon's apparent center and the star, we put α_1 and δ_1 for the apparent coordinates of the star. We then have, with sufficient precision,

$$\left.\begin{aligned} D \sin m_1 &= (\alpha' - \alpha_1) \cos \tfrac{1}{2}(\delta' + \delta_1), \\ D \cos m_1 &= \delta' - \delta_1. \end{aligned}\right\} \tag{9}$$

Having found D and m_1, the subsequent computation of the differential coefficients scarcely differs except in arrangement and order of quantities from that used in the longitudes.

Coefficients of the Equations of Condition for Correcting the Provisional Elements.

10. Heretofore observations of occultations have been used only for correcting the apparent position of the moon, and occasionally one or more of the lunar elements. But it will be of interest, and may prove of scientific value, to introduce a wider range of corrections, including certain elements pertaining to the position of the occulted stars as well as to the elements of the moon's motion. We have already mentioned the two drawbacks incident to meridian observations of the moon—the varying personal equation of the observers and the systematic error liable to arise in the observed declination through the rapid motion of the moon in declination. The latter introduces an element of uncertainty in the determination of the moon's node and inclination from meridian observations. The only two elements which we can confidently base entirely on this class of observations are the eccentricity and the perigee. Even in the case of the latter the motion may be defective because the meridian observations for determining it commenced with Bradley, and have not yet been satisfactorily worked up and discussed. Since accurate observations of occultations commenced about 80 years before Bradley's time, they can be used with advantage to determine the motion of the perigee.

Although not strictly an element, the parallactic inequality should be determined from observation. The reasons for this, and the principles on which other elements may be determined have been set forth in the preceding chapter.

To form the equations of condition for the corrections of the elements of reduction, we proceed thus: each observed occultation gives rise to a conditional equation of the form

$$s' - D = \Delta D, \tag{10}$$

where ΔD is the symbolic increment of D, which is to be expressed in terms of corrections to the various elements. To form this expression the derivatives of D with respect to the elements are to be formed. We regard the moon's parallax and the elements related to it as sufficiently well determined. Moreover, as the corrections to the geocentric longitude differ from those to the apparent longitude by a factor which at its maximum is only about 0.016, we regard the corrections $\Delta l'$ and $\Delta b'$ as equal to those of the moon's geocentric coordinates Δl and Δb.

The formulæ of correction are, in terms of coordinates,

(A) with ecliptical coordinates:

$$\Delta D = (\Delta l' - \Delta L) \cos B \sin m + (\Delta b' - \Delta B) \cos m. \tag{11}$$

(B) with equatorial coordinates:

$$\Delta D = (\Delta \alpha' - \Delta \alpha_1) \cos \delta' \sin m_1 + (\Delta \delta' - \Delta \delta_1) \cos m_1. \tag{12}$$

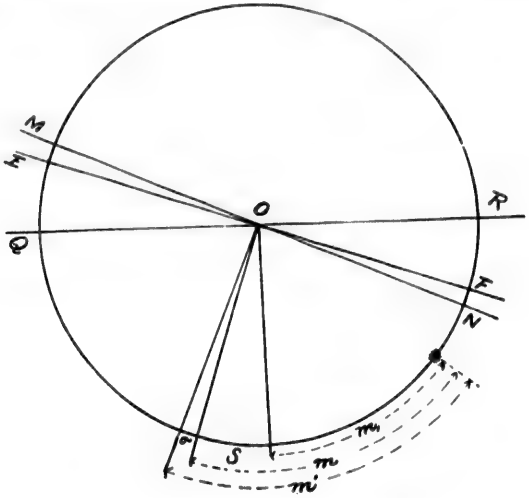
Practically, we may take $\cos B = 1$, and may take for δ' the declination of either the moon or the star, or their half sum.

(C) It is sometimes necessary to refer the corrections to the moon's longitude in orbit, v. We may then use

$$\Delta D = (\Delta v' - \Delta L) \sin m' + (\Delta \beta' - \Delta B) \cos m', \tag{13}$$

m' being the position angle corresponding to the plane of the moon's orbit, which is introduced in §12.

In any critical revision of the work it is necessary to distinguish clearly the three measures m, m_1, and m' of the position angle of the line joining the star and the center of the moon. The angles have already been fully defined; but their understanding will be facilitated by the accompanying diagram.



We have now to express these corrections to the coordinates of the two bodies in terms of corrections to the fundamental elements.

Corrections to the Coordinates of the Stars.

11. We regard the mean of all the corrections to the right ascensions and that of all the corrections to the declinations, as quantities varying uniformly with the time. Let us put

$\varDelta\alpha$, this correction in right ascension;
$\varDelta\delta$, this correction in declination;
$\varDelta\varepsilon$, the correction to the obliquity of the ecliptic.

If we determine an angle S from either of the equations

$$\left.\begin{aligned}\sin S &= \cos\alpha \sec B \sin\varepsilon,\\ \sin S &= \cos L \sec\delta \sin\varepsilon,\end{aligned}\right\} \tag{14}$$

we shall have

$$\begin{aligned}\cos B\, \varDelta L &= \cos S \cos\delta\, \varDelta\alpha + \sin S\, \varDelta\delta + \sin B \cos L\, \varDelta\varepsilon,\\ \cos B\, \varDelta B &= -\sin S \cos\delta\, \varDelta\alpha + \cos S\, \varDelta\delta - \sin L\, \varDelta\varepsilon.\end{aligned}$$

By substituting these values in (11) and putting, as we may, $\cos B = 1$, which gives

$$\sin S = \sin\varepsilon \cos\alpha,$$

we find

$$\begin{aligned}\Delta D = &-\sin(m-S)\cos\delta\,\Delta\alpha\\ &-\cos(m-S)\,\Delta\delta\\ &+(\cos m\sin L-\sin m\sin B\cos L)\,\Delta\epsilon.\end{aligned}$$

We have, in (12)

$$m_1 = m - S.$$

Putting

$$\begin{aligned}h\sin H &= \sin B\cos L,\\ h\cos H &= \sin L,\end{aligned}$$

we shall have

$$\Delta D = -\sin m_1\,\Delta\alpha - \cos m_1\,\Delta\delta + h\cos(m+H)\,\Delta\epsilon. \qquad (15)$$

Since

$$h^2 = \sin^2 L + \sin^2 B\cos^2 L,$$

we may put, when $\sin^2 B$ is dropped,

$$h = \sin L.$$

From $\tan H = \sin B\cot L$, we see that near the equinoxes H may approach 90°. But in this case h will become small, and the coefficient become unimportant, and may be dropped. In the second semicircle the argument becomes $L-180°$, and the signs of h and H are to be changed.

Coefficients of the Corrections to the Lunar Elements.

12. In the case of the corrections to the lunar elements, we first replace Δl and Δb by the corrections to the longitude in orbit, and to the latitude in a direction perpendicular to the plane of the orbit. We replace the position angle m by one counted from a perpendicular to this orbit as an origin by introducing the angle σ between the apparent orbit of the moon on the celestial sphere, and a parallel to the ecliptic. Then, putting $u=v-\theta$, the argument of latitude, we have

$$\sin\sigma = \sin i\cos u; \qquad (16)$$

we compute

$$m' = m + \sigma,$$

and putting Δv, $\Delta\beta$ for the correction to the orbital longitude and latitude, we then have

$$\sin m\,\Delta l' + \cos m\,\Delta b' = \sin m'\,\Delta v + \cos m'\,\Delta\beta.$$

In terms of corrections to the elements and a constant error of any kind in the theoretical latitude, we have

$$\Delta\beta = \Delta i\sin u - i\Delta\theta\cos u + \Delta\beta_0. \qquad (17)$$

Put

$\Delta\lambda$, the correction to the moon's mean longitude;
$\Delta\pi$, that to the longitude of the perigee;
ΔP, that to the parallactic coefficient.

For the corrections to the moon's longitudinal elements, we have

$$\Delta v = \Delta\lambda(1+2e\cos g) - 2e\Delta\pi\cos g + \Delta P\sin \mathrm{D}\ (g = \text{moon's mean anomaly}). \qquad (18)$$

The equation (15) with the additional terms formed by substituting (17) and (18) in (11) or (13), as the case may be, will be the complete conditional equation having ΔD as its absolute term. The coefficients of the unknown quantities in the expression for ΔD are found to be as follows, putting $F=1+2e\cos g$:

$$\left.\begin{array}{llrl}
\text{Coefficient} & \text{of} & \Delta\alpha_0 = & -\sin m_1 \cos\delta, \\
\text{“} & \text{“} & \Delta\lambda = & F\sin m', \\
\text{“} & \text{“} & 2e\,\Delta\pi = & -\sin m' \cos g, \\
\text{“} & \text{“} & \Delta P = & \sin m' \sin \mathrm{D}, \\
\text{“} & \text{“} & \Delta i = & \cos m' \sin u, \\
\text{“} & \text{“} & i\,\Delta\theta = & -\cos m' \cos u, \\
\text{“} & \text{“} & \Delta\varepsilon = & \sin L \cos(m+H), \\
\text{“} & \text{“} & \Delta\beta_0 = & \cos m', \\
\text{“} & \text{“} & \Delta\delta_0 = & -\cos m_1.
\end{array}\right\} \qquad (19)$$

F, the factor for reducing the correction of the mean longitude to that of the true, can generally be found most readily by taking for it the ratio of the rates of change of these two quantities in any unit of time; that is

$$F=\frac{D_t v}{D_t \lambda}.$$

The value thus found will not be rigorously equal to the other, but the difference is practically unimportant, and, withal, the second value is the better.

In the reductions where longitudes were used the motion in longitude for .01 of a day was computed. We then have

$$F=\frac{D_t l}{7'.906}.$$

In the preceding formulæ the coefficient $\Delta\varepsilon$ is expressed in terms of the ecliptical coordinates of the star. As these coordinates are not used after 1862.0 it will be convenient to express $\frac{d}{d\varepsilon}D$ in terms of equatorial coordinates. We then have

$$\frac{d}{d\varepsilon}D=\sin\alpha\cos m_1-\sin\delta\cos\alpha\sin m_1.$$

It is indifferent whether we take for α and δ the coordinates of the moon or those of the star. In the latter case, if the star is one of which many occultations are used, the expression may be reduced to a monomial. But in the present case the computation has been made in the preceding form unchanged, natural numbers being used.

As m, m_1, m' do not differ greatly in value, there will arise between the coefficients of $\Delta\alpha_0$ and $\Delta\lambda$ approximations to equality, as also between those of $\Delta\delta_0$ and $\Delta\beta_0$, which will weaken the separate determination of these quantities by the solution of the equations. We shall therefore introduce, instead of $\Delta\lambda$ and $\Delta\beta_0$, the linear combinations

$$\begin{aligned}\Delta\lambda' &= \Delta\lambda-\Delta\alpha_0,\\ \Delta\beta_0' &= \Delta\beta_0-\Delta\delta_0,\end{aligned}$$

which may be done by the substitution

$$\begin{aligned}\Delta\lambda &= \Delta\lambda'+\Delta\alpha_0,\\ \Delta\beta_0 &= \Delta\beta_0'+\Delta\delta_0;\end{aligned}$$

we shall then have

$$\begin{aligned}
&\text{Coefficient of } \Delta\lambda' = F \sin m', \\
&\text{" \quad " } \Delta\beta_0' = \cos m', \\
&\text{" \quad " } \Delta\alpha_0 = F \sin m' - \sin m_1 \cos \delta, \\
&\text{" \quad " } \Delta\delta_0 = \cos m' - \cos m_1.
\end{aligned}$$

The preceding expression of ΔD in terms of corrections to the elements of reduction are, of course, the same whatever system of coordinates is used in the reductions. When the ecliptic system is used, m is computed in the reductions, while m_1 is computed when the equatorial system is used. For dates posterior to 1862 the factor F may be most conveniently formed by taking the moon's apparent path and rate of motion on the celestial sphere, and deriving from them the position and angular speed in the apparent orbit. Putting

$$\gamma = S + \sigma,$$

the angle which the moon's orbit makes with a parallel to the equator, and

$$v' = D_t v',$$

the moon's motion in longitude, the value of v' and of γ may be derived from the data of the hourly ephemeris by the equations

$$\begin{aligned}
v' \sin \gamma &= D_t\delta, \\
v' \cos \gamma &= \cos \delta \, D_t\alpha.
\end{aligned}$$

The factor F is then computed by

$$F = \frac{v'}{32.9} = [8.483] \, v'.$$

Here the divisor 32.9 is the mean motion of the moon in seconds of arc per minute of time.

The formulæ for the differential coefficients now become

$$\begin{aligned}
m' &= m_1 + \gamma, \\
\frac{dD}{d\lambda} &= F \sin (m_1 + \gamma), \\
\frac{dD}{d\beta} &= \cos (m_1 + \gamma).
\end{aligned}$$

$\frac{dD}{di}$ and $\frac{dD}{id\theta}$ are then found by multiplying $\frac{dD}{d\beta}$ by $\sin u$ and $-\cos u$ as before.

Transformation of Published Reductions.

13. In several published series of occultations the symbolic expression of ΔD, in terms of corrections to the moon's coordinates, is computed and given. In these cases our problem is that of transforming these corrections into the corrections of the adopted elements. Among the series of this kind are those of Greenwich, Cambridge (Eng.), the Cape of Good Hope, and, for the period 1862–1876, the Radcliffe observations at Oxford. In these four cases the coefficients of correction to the right ascension and declination of the moon are given. Other published results may be utilized in much the same way, because the coefficient of the correction of the coordinates of the star is practically equal to that of the coordinates of the moon.

In the case of the Greenwich observations the results are presented in the following way. The notation used in the published volumes, expressed in terms of our own, is

$x = \Delta\alpha$, correction of moon's right ascension;
$y = -\Delta\delta$, correction of moon's N. P. D.;
$e = \Delta\alpha_1$, correction of star's R. A.;
$f = -\Delta\delta_1$, correction of star's north polar distance;
$m = 1000\,\Delta\pi$, factor of correction to the equatorial horizontal parallax;
$n = 1000\dfrac{\Delta s}{s}$, factor of correction of moon's semidiameter.

There are other corrections introduced which we do not deem it necessary and practicable to take account of in the present work. In the case of each occultation an equation of condition is derived and expressed in a form which we may write

$$\Delta D = -h\times e'' - g\times f'' + h\times x'' + g\times y'' + [\pi]\times m - [s]\times n,$$

h, g, $[\pi]$ and $[s]$ being numerical coefficients given in the volumes of Greenwich observations. From the latter the position angle m_1 may be at once derived by either or both the equations

$$\sin m_1 = h \sec\delta,$$
$$\cos m_1 = -g;$$

γ and F may then be computed from the equations already given, using the motion of the hourly ephemeris of the moon. But the Greenwich volumes give the motion of α and $-\delta$ for a second of time. If we use these motions instead of referring to the ephemeris, the equations are

$$v' \sin\gamma = -D_t(\text{N. P. D.}),$$
$$v' \cos\gamma = \cos\delta\; D_t(\text{R. A.}),$$
$$F = \frac{v'}{0.548} = [0.261]\; v'.$$

Then we form $m' = m_1 + \gamma$ and proceed as before.

The same is true of the Cape observations except that declination is used instead of N. P. D., and instead of m and n the increments of π and s are expressed by the quantities p and s, where, with a sufficient approximation,

$$p = \frac{\Delta\pi}{\sin\pi}, \qquad s = \frac{\Delta s}{\sin s}.$$

The Cape equation may therefore, by using our Greenwich notation, be expressed in the form

$$\Delta D = h\;\Delta\alpha - g\;\Delta\delta - h\;\Delta\alpha_1 + g\;\Delta\delta_1 + 1000\;[\pi]p - 1000[s]s.$$

In the Radcliffe and Cambridge observations the results are given in the same form as in the case of Greenwich.

If we aim at rigor the parallactic corrections require special attention. At Greenwich, Oxford, and the Cape, the compression

$$a = \frac{1}{300}$$

has been adopted in the published reductions. We thus have, with Helmert's compression (page 18), for use in the formulæ (7),

$$\Delta a = +0.000\;020,$$

which gives

$$\Delta(\rho\sin\pi) = 0''.40 - 0''.06\sin^2\varphi.$$

This correction to the local horizontal parallax is

For England, $\Delta(\rho \sin \pi)=0''.36$, $m=+0.105$;
For the Cape, $\Delta(\rho \sin \pi)=0''.38$, $p=+0.111\div10^3$.

The semidiameter generally used in the Greenwich reductions is

1826 to 1899, $s_0=934''.08$ (Hansen), hence $n=-1''.60$;
1900 and later, $s_0=932''.65$ (Struve), hence $n=-0''.07$.

In the Cape reductions was used

$$s=[9.43559]\pi.$$

The constant of π in Hansen's tables being $3422''.23$, this gives

$$s_0=933''.04,\ \text{hence}\ s=-0''.49\div10^3.$$

At Oxford Hansen's semidiameter was used, so that the value of m and n are the same as for Greenwich.

CHAPTER III.

REDUCTION OF HANSEN'S TABLES TO THE PROVISIONALLY ACCEPTED THEORY.

SECTION I.—CORRECTIONS TO THE LONGITUDE.

14. The researches of the past 30 years have shown that the inequalities tabulated in Hansen's Tables de la Lune, and originally used as the theoretical basis of the present work, require a great number of small corrections and additions to reduce the results to the now accepted theory. It is necessary to collect and apply such of these corrections as would materially affect the results to be derived from the comparison with observations. It is not, however, necessary that rigorous numerical precision should be aimed at. Were such the case, it would practically be necessary to construct new tables of the moon. This necessity is evaded by the consideration that small periodic errors in the theory compared, especially if the period is short, will merge themselves with the errors of observation. A possible exception occurs in the case of those so related to the argument of the moon's elongation from the sun that the unequal distribution of the observations in the lunation would result in an error in the adopted coefficient leading to a systematic error in the conclusion. Cases of this sort have been pointed out by Cowell in his discussion of Greenwich observations of the moon. Without attempting to form a rigorous criterion to determine whether a given correction is necessary, the following general principles will serve to guide our decision:

(A) Every correction which amounts to a large fraction of the probable error of a single observation should be included. Applying this rule to individual terms a correction of 0''.3 would be unimportant in the case of a single observation. But the accumulated effect of a large number of such corrections may be frequently important. It is therefore advisable to introduce all corrections exceeding 0''.2. Many of these small corrections can be introduced without much additional labor.

(B) Up to a certain limit the longer the period of the correction the more important it will be, for the obvious reason that it will affect a longer series of observations in the same way. We may therefore make a distinction between the solar terms, of which the period is generally of the order of magnitude of a month, and the planetary terms, of which the period may be one or more years. In the latter case greater precision is required, but in the case of periods much exceeding that of the moon's node the correction again becomes less necessary, because it will be merged with the unknown inequalities of very long period in the mean longitude.

(C) The parallactic inequality being one which is to be determined from the observations, it is necessary that the coefficients related to it should be determined as accurately as possible.

These considerations lead to the division of the corrections into two classes. One comprises those of the longest period, which merge with those which have to be determined from observations alone, and which therefore need not be applied in advance. When the observed value of the fluctuations having a period greater than that of the moon's node are mapped out it can be determined by a comparison with the best theory what the outstanding residual correction is. We shall therefore consider in the present chapter only those terms which for the reasons above mentioned are to be applied in advance of the discussion. These corrections, so far as they could be determined, were constructed, tabulated, and applied in 1904, when Brown's lunar theory was still incomplete, and when the best determination of the planetary terms was that of Radau. After this work was done Brown's completed theory appeared, and should supersede the corrections which had been used. Early in 1907 the author completed and published his reinvestigation of the action of the planets on the moon, which appeared in June of that year as Publication No. 72 of the Carnegie Institution. The tables were now reconstructed so as to reduce them to Brown's theory of the solar terms and my own computation of the planetary terms.

The foregoing considerations apply to periodic terms in the longitude. But it may be necessary also to correct some of the elements in advance. Of these the eccentricity and inclination of the moon's orbit are of secondary consideration because they can probably be better determined from meridian observations. The former has, however, been included. The semidiameter is excluded because it has been determined with all required precision by Peters and by Struve. The parallax is not included because its theoretical value for the mean radius of the earth is beyond serious doubt. Its value for special points of observation depends on the compression of the geoid; but the question whether the value of this constant can be determined from the occultations must be postponed to the end of the work.

Errors of short period will have no systematic effect on any of the elements to be determined, except the parallactic inequality, but will be merged with the accidental errors, which they will increase only when so large as to be an important fraction of their amount. So long as the average sum of all the theoretical errors of short period does not exceed 0″.3, they will be of no importance in the present work.

Corrections of Long Period.

15. Were the inequalities of long period in the mean longitude determined by theory with unquestionable completeness and rigor, and did the result agree fairly well with observations, we should adopt the results of theory as the basis for the ephemeris of comparison. But as entire rigor in this respect can not be assumed at the time the present work is being carried on, it seems better to leave the question of the ultimate outstanding difference between theory and observation to be discussed when the former is brought as near as may be to completeness. Moreover, the discrepancy between theory and observation is, so far as yet appears, too large to admit of the convenient and precise determination of the unknown quantities of the equations unless an empirical correction is applied to the mean longitude so as to reduce the residuals left by observations. Under these circumstances the most eligible course seems to be to take the corrections, empirical and otherwise, to Hansen's tables, which have been applied in the Ephemerides since 1883, as the basis of the ephemeris of comparison. The corrections thus derived will be nearly but not rigorously identical with those derived and tabulated in the Researches of 1878, page 268. As used in the Ephemerides from 1883, the corrections of long period to Hansen's tables are as follows:

We put V_2 for the empirical Venus term, wrongly introduced by Hansen to represent observations. We also put A for the argument of the other Hansenian term, of which Hansen's coefficient is in error by approximately 1″. Then

$$V_2 = 21''.47 \sin (8V - 13E + 274^\circ\ 14'),$$

This Argument, in [illegible] = 136°.61 + 150°.685 T in centuries from 1800.0. cf. Naut. Alm. 1915 p

$$A = 18V - 16E - g,$$

$$\text{Empirical term} = -15''.5 \cos A.$$

(For A see page [illegible])

The total secular correction to Hansen's mean longitude, long-period terms included, which has been used in the Ephemerides since 1883, then becomes

$$\delta\lambda = -V_2 - 1''.14 - 29''.17\,T - 3''.76\,T^2 - 15''.5 \cos A. \qquad (20)$$

The most convenient way of applying this correction is to omit Hansen's Table XLI and to replace it by the sum of the above terms, omitting the first. We may tabulate the sum thus found as a function of the time. Since Hansen's Table XLI contains the constant 21.″49, which will be omitted with the table, this constant must be applied in the new table. If this process is followed, the quantity by which to replace Table XLI is

$$20''.35 - 29''.17\,T - 3''.76\,T^2 - 15''.50 \cos A. \tag{21}$$

When the longitude is first computed from Hansen's tables unchanged, the original correction (20) is to be used. Its value is tabulated for 10-year intervals in the following scheme, where column C gives the value of $-1''.14 - 29''.17\,T - 3''.76\,T^2$.

Corrections of Long Period and Secular Corrections to Hansen's Mean Longitude.

Year.	Arg. A.	$-V_2$ See p.29	$-15''.5 \cos A$	C	$\delta\lambda$
	°	"	"	"	"
1630	319.63	+18.67	−11.81	+37.58	+44.44
1640	332.82	+20.78	−13.79	+35.90	+42.89
1650	346.01	+21.46	−15.04	+34.16	+40.58
1660	359.20	+20.66	−15.50	+32.33	+37.49
1670	12.39	+18.45	−15.14	+30.43	+33.74
1680	25.58	+14.98	−13.98	+28.46	+29.46
1690	38.77	+10.45	−12.08	+26.40	+24.77
1700	51.96	+ 5.22	− 9.54	+24.27	+19.95
1710	65.15	− 0.38	− 6.51	+22.06	+15.17
1720	78.34	− 5.94	− 3.13	+19.79	+10.72
1730	91.53	−11.10	+ 0.41	+17.44	+ 6.75
1740	104.72	−15.49	+ 3.94	+15.01	+ 3.46
1750	117.91	−18.82	+ 7.26	+12.51	+ 0.95
1760	131.10	−20.85	+10.17	+ 9.93	− 0.75
1770	144.29	−21.45	+12.59	+ 7.27	− 1.59
1780	157.48	−20.58	+14.32	+ 4.55	− 1.71
1790	170.67	−18.28	+15.29	+ 1.74	− 1.25
1800	183.86	−14.73	+15.46	− 1.14	− 0.41
1810	197.05	−10.17	+14.82	− 4.10	+ 0.55
1820	210.24	− 4.92	+13.39	− 7.12	+ 1.35
1830	223.43	+ 0.68	+11.26	−10.23	+ 1.71
1840	236.62	+ 6.23	+ 8.53	−13.41	+ 1.35
1850	249.81	+11.35	+ 5.35	−16.66	+ 0.04
1860	263.00	+15.71	+ 1.89	−19.99	− 2.39
1870	276.19	+18.97	− 1.67	−23.40	− 6.10
1880	289.38	+20.93	− 5.14	−26.89	−11.10
1890	302.57	+21.46	− 8.34	−30.44	−17.32
1900	315.76	+20.50	−11.10	−34.07	−24.67
1910	328.95	+18.14	−13.28	−37.78	−32.92
1920	342.14	+14.52	−14.75		

Corrections of Mean Period.

16. Under this head we first include terms in which the argument contains the longitude of the moon's node and which arise from the compression of the earth and the motion of the ecliptic. Although most of these terms are of short period in the longitude, they arise from changes in the elements having periods of the order of magnitude of the time of revolution of the node. In Hansen's tables these terms are

$$n\delta z = +7''.760 \sin (\Omega - 4^\circ\ 42') - 0''.035 \sin 2\Omega$$
$$-0''.128 \sin (g + \Omega) + 0''.128 \sin (g - \Omega).$$

For the purpose of comparison these terms in the mean anomaly must be transformed into terms of longitude. The transformation gives

$$\delta l = +7''.594 \sin \Omega - 0''.636 \cos \Omega - 0''.035 \sin 2\Omega$$
$$+0''.30 \sin (g + \Omega) - 0''.30 \sin (g - \Omega).$$

I shall take Hill's investigation of the inequalities due to the compression of the earth[a] as the basis of the provisional theory. The terms found by Hill of a magnitude to be considered are

$$\begin{aligned}\delta l = &+7''.671 \sin ☊ - 0''.040 \sin 2☊\\ &+0''.520 \sin (g+☊) - 0''.519 \sin (g-☊)\\ &+0''.096 \sin (2D+☊) - 0''.064 \sin (2D-☊).\end{aligned}$$

Hill has also computed the terms produced by the motion of the ecliptic and found from this source

$$\delta l = 0''.029 \sin ☊ - 0''.285 \cos ☊.$$

My own result of 1907 is

$$\delta l = 0''.030 \sin ☊ - 0''.273 \cos ☊.$$

The terms depending on ☊ become

$$7''.701 \sin ☊ - 0''.273 \cos ☊.$$

Omitting minute terms of period so short as to be unimportant, we find that the true longitude of Hansen's tables requires the following corrections depending on ☊ to reduce it to the provisional theory.

$$\begin{aligned}\delta l = &+0''.107 \sin ☊ + 0''.363 \cos ☊\\ &+0''.22 \sin (g+☊) - 0''.22 \sin (g-☊).\end{aligned}$$

Reduced to a monomial the first two terms are

$$\delta l = 0''.378 \sin (☊ + 73^\circ.6).$$

The Jovian Evection and Similar Terms.

17. The most important theoretical correction still needed to Hansen's tables is the Jovian evection. This is related to the preceding terms in a way to add interest to the history of its discovery. In 1875 the present writer published a discussion of the corrections required to Hansen's Tables de la Lune, both from theory and observation. When the corrections to the eccentricity and perigee were worked out, they were found to be affected with a well-marked fluctuation in a period of about 17 years. The resulting coefficient in the longitude as found from the observations was 1''.50. The discussion gave the correction of longitude

$$\delta l = 1''.50 \sin [g + 21^\circ.6\,(t - 1865.1)].$$

Shortly after this publication Neison showed that this inequality was mainly due to the action of Jupiter in the same way that the ordinary evection is due to the action of the sun. From theory he found for the term[b]

$$\delta l = -1''.16 \sin (2\pi - 2J + g),$$

J being the mean longitude of Jupiter and π that of the moon's perigee.

In 1885 Hill published a very careful recomputation of this and the related terms, leading to the result

$$\delta l = -0''.903 \sin (2\pi - 2J + g).$$

---

[a] Astronomical Papers of the American Ephemeris, Vol. III, Part II.

[b] Monthly Notices, R. A. S., Vol. XXXVII, pp. 248, 358.

Radau reduced the coefficient still farther to 0″.881, a value little more than half that found from observation.[a]

In 1904 Dr. Frank E. Ross, research assistant of the Carnegie Institution, working under the writer's direction, made a computation of the action of Jupiter on the moon, using the moon's coordinates as affected by the action of the sun. The result was the discovery of certain important terms due to the indirect action of Jupiter, and omitted by Hill and Radau, which carried the coefficient up to 1″.15. This result is verified by me in the work of 1907.

An important point in this connection is that the annual motion of the argument $2J-2\pi$ differs by only 1°.31 from that of the moon's node. The result is that the terms depending on the node and this argument will combine themselves together during a space of many years, and a cycle of 274 years will be required to complete the separation of the effects. The result is best shown by treating both terms as inequalities of long period in the eccentricity and perigee. If we express the effect on the longitude of the moon in the form

$$\delta l = h \sin g + k \cos g,$$

where $h=2\delta e$ and $k=-2e\,\delta\pi$, the values of h and k for the Jovian evection, and for the corresponding correction to Hansen's terms depending on Ω are, from theory,

$$h=-1''.15 \cos(2\pi-2J),$$
$$k=-1''.15 \sin(2\pi-2J)+0''.44 \sin \Omega.$$

With the last term of k may be combined the inequality of π arising from the motion of the ecliptic and planetary action derived in "Action II,"

$$\delta\pi=-0''.10 \sin \Omega+0''.80 \cos \Omega.$$

This gives the terms

$$+0''.01 \sin \Omega-0''.09 \cos \Omega,$$

in k, making the entire term

$$+0''.45 \sin \Omega-0''.09 \cos \Omega.$$

The numerical values of the arguments are

$$\Omega=146^\circ.20-19^\circ.3415\,(t-1850.0),$$
$$2\pi-2J=239^\circ.85+20^\circ.6550\,(t-1850.0).$$

.8502

The amplitude of k reaches nearly its maximum when

$$2\pi-2J+\Omega=0,$$

which was the case in 1830. In 1825 and 1834, k reached maxima numerical values of $-1''.59$ and $+1''.59$, respectively. In 1898 the apparent augmentation of the Jovian evection vanished, to give place to a diminution in subsequent years, the minimum being reached in 1967.

Certain other terms of period approximating to that of the node, omitted by Hansen, but computed by subsequent authorities, may be associated with these. The most important as computed by Radau and by the author are

Radau.	Newcomb.
$\delta l=+0''.206 \sin(2\pi-2J)$	$+0''.256 \sin(2\pi-2J)$
$+0''.194 \sin(2\pi-3J+267^\circ.5)$	$+0''.258 \sin(2\pi-3J+268^\circ.2)$
$+0''.316 \sin(2\pi-3J+g+267^\circ.5)$.	$+0''.445 \sin(2\pi-3J+g+268^\circ.0)$.

The inequality containing g in its argument is most easily expressed by adding to h and k the terms

Radau.	Newcomb.
$h=0''.316 \cos(2\pi-3J+267^\circ.5)$,	$h=0''.445 \cos(2\pi-3J+268^\circ.0)$,
$k=0''.316 \sin(2\pi-3J+267^\circ.5)$,	$k=0''.445 \sin(2\pi-3J+268^\circ.0)$.

---

[a] "Recherches concernant les Inegalités Planétaires du Mouvement de la Lune" Annales de l'Observatoire de Paris, Memoires 21, p. B 113.

The value of the argument is

$$2\pi-3J=179^\circ.4-9^\circ.6940\ (t-1850.0).$$

Terms of similar period due to the action of Jupiter, Mars, and Venus, as computed by the author, are

$$\begin{aligned}\delta l=&+0''.183\sin(\text{J}+22^\circ.5)\\&+0''.372\sin(2\text{M}-g'+328^\circ.7)\\&+0''.095\sin(4\text{M}-2g'+89^\circ)\\&+0''.072\sin(2\pi+3\text{V}-5g'),\end{aligned}$$

where M, V, J, and π are measured from the earth's perihelion for 1800, ($\pi'=99^\circ.5$), and g' is the sun's or earth's mean anomaly. The only corresponding inequalities in Hansen's tables are

$$\begin{aligned}\delta l=&+0''.320\sin(2\text{M}-g'+328^\circ)\\&+0''.099\sin(4\text{M}-2g'+87^\circ).\end{aligned}$$

The following inequalities produced by Venus, were computed by Radau and by Brown, but not by the writer:

$$\begin{aligned}\delta l=&+0''.13\sin(2\text{D}-g+21\text{E}-20\text{V}+273^\circ)\\&+0''.11\sin(g+29\text{E}-26\text{V}+112^\circ).\end{aligned}$$

Planetary Terms of Short Period.

18. The following inequalities of shorter period, some of which have been omitted by Hansen, may be deemed worthy of application:

Action of Venus.

Newcomb.	Hansen.
$\delta l=-0''.88\sin(\text{V}-g')$	$-1''.10\sin(\text{V}-\text{E})$
$+0''.40\sin 2(\text{V}-g')$	$+0''.43\sin 2(\text{V}-\text{E})$
$-0''.04\sin 3(\text{V}-g')$	$-0''.07\sin 3(\text{V}-\text{E})$.
$+0''.35\sin(2\text{V}-3g'+164^\circ.3)$	
$+0''.20\sin(3\text{V}-4g'+168^\circ.3)$	
$-0''.65\sin(g+2\pi+3\text{V}-5g')$.	

Neglecting terms of short period less than 0''.20, it seems that by putting, for brevity,

$$\text{L}=\text{V}-g'=\text{V}-\text{E},$$

we have the following terms of correction to Hansen depending on the arguments L and g':

$$\begin{aligned}\delta l=&+0''.22\sin\text{L}\\&+0''.35\sin(2\text{L}-g'+164^\circ.3)\\&+0''.20\sin(3\text{L}-g'+168^\circ.3).\end{aligned}$$

The term depending on the argument $g+2\pi+3\text{V}-5g'$ may most conveniently be developed as an inequality of h and k with a period of nearly 10 years. A number of other small terms ranging between 0''.10 and 0''.23 are collected later.

The remaining terms included by Hansen are

Action of Mars.

Newcomb.	Hansen.
$\delta l=+0''.011\sin(g'-\text{M})$	$+0''.031\sin(\text{E}-\text{M})$
$+0''.224\sin 2(g'-\text{M})$	$+0''.241\sin 2(\text{E}-\text{M})$
$+0''.372\sin(2\text{M}-g'+329^\circ)$	$+0''.320\sin(2\text{M}-\text{E}+228^\circ)$
$+0''.095\sin(4\text{M}-2g'+89^\circ)$	$+0''.099\sin(4\text{M}-2\text{E}+248^\circ)$

Action of Jupiter.

Newcomb.	Hansen.
$\delta l = +0''.74 \sin (g' - \mathrm{J} + 1^\circ.2)$	$+0''.74 \sin (\mathrm{E} - \mathrm{J})$
$-0''.24 \sin 2(g' - \mathrm{J}).$	$-0''.24 \sin 2(\mathrm{E} - \mathrm{J}).$

None of these six terms needs correction.

Solar Terms of Short Period.

19. Among all the errors of Hansen's tables the most troublesome is that of the parallactic equation. The original theory started with certain numbers which he afterward found to correspond to a solar parallax of 8″.6085. On this basis Hansen found for the parallactic term in $n\delta z$, the mean longitude, a theoretical coefficient of

$$-121''.368.$$

By comparison with observations he found that this coefficient should be multiplied by the factor

$$1.03573,$$

thus changing the coefficient by 4″.336 and carrying it to

$$-125''.704.$$

This increase is nearly double that given by observation.[a]

To facilitate the discussion of the corrections we compare the Hansenian tabular coefficients of the four principal parallactic terms with the values found by Delaunay and by Brown as follows:

Table of Parallactic Terms.

Theory of Hansen's tables.				Delaunay.	Brown.
Arg	$n\delta z$	δv	$1.03573\ \delta v$	$\pi = 8''.78$	$\pi = 8''.78$
	″	″	″	″	″
D	−121.368	−122.065	−126.43	−124.42	−124.78
$\mathrm{D}+g'$	+ 17.489	+ 17.524	+ 18.15	+ 18.14	+ 17.99
$\mathrm{D}-g$	− 11.692	− 18.490	− 19.15	− 18.82	− 18.55
$\mathrm{D}+g$	− 1.614	− 8.244	− 8.54	− 8.56	− 8.44

It appears that there is a substantial agreement between Hansen and Delaunay as to the theoretical value of the minor parallactic terms corresponding to a given value of the solar parallax, except in the case of the argument $\mathrm{D}-g$. Here the subsequent computation by Hansen, found in his Darlegung, gives a coefficient numerically less by 0″.292 than that of the tables. This brings his theory into better agreement with Brown, which last shows a large coefficient of correction, 0″.60, to the tables.

As a definitive theoretical value of the parallactic inequality was not established with numerical rigor when this work was commenced, I provisionally applied a diminution of 1″.60 to Hansen's implicit coefficient of the inequality in ecliptic longitude, reducing it to −124″.83, a value corresponding to a value of the solar parallax of about 8″.783. Applying the corresponding increment to the three other terms of Brown's theory, the total adopted correction is

---

[a] A portion of the error may be conjecturally accounted for on the theory that Hansen took the coefficient of the term in the ecliptic longitude, which is greater by 0″.7 than that in $n\delta z$, as if it were applicable to the latter.

$$
\begin{aligned}
\delta l' = & +1''.60 \sin D \\
& -0''.15 \sin (D+g') \\
& +0''.59 \sin (D-g) \\
& +0''.10 \sin (D+g)
\end{aligned}
$$

Annual Equation.

20. For this we have

	''
Hansen (tables)	$-669.90 \sin g'$
Reduction to 1850	$+\ \ 0.83 \sin g'$
Factor, .000154	$-\ \ 0.10 \sin g'$
Hansen (tables, 1850)	$-669.17 \sin g'$
Brown	$-668.94 \sin g'$
Correction to Hansen	$+\ \ 0.23 \sin g'$

Evection and Variation.

The variation is closely associated with the parallactic inequality, because an error in the one will affect the determination of the other from observation unless observations are equally numerous on both sides of the moon's quadratures, which is not the case. It is well known that Hansen multiplied these and the other inequalities in the moon's longitude by the factor 1.0001544 on account of a supposed noncoincidence of the moon's center of gravity and of figure. I have shown that this correction is not well founded and that the apparent augmentation of the two largest inequalities grew mainly out of the fact that Hansen's theoretical value of the coefficient of evection was too small because his eccentricity was too small. Also that the value of the variation derived from meridian observations is too large through excess of the apparent semidiameter of the moon from first to last quarter over the semidiameter from last to first quarter, which excess is due to irradiation. It is therefore necessary to reduce the coefficients of evection and variation adopted in Hansen's tables to their theoretical values.

For the theoretical variation in ecliptic longitude we have:

	''
Hansen's original tabular theory	2369.77 sin 2D
As used in tables, with increase	2370.13 sin 2D
Theory in Darlegung	2369.75 sin 2D
Delaunay's theory	2369.74 sin 2D
Brown's theory	2369.90 sin 2D

In "Action II" an increment of 0''.02 is derived from the action of the planets. The tables therefore require the correction

$$\delta l = -\ 0''.21 \sin 2D.$$

The theoretical evection contains the eccentricity as a factor. Hansen's coefficient was computed with a value of e less by 1''.15 than that finally introduced in the tables; but the tabular value was not increased to correspond, as it should have been. In the theory on which the tables were based, the value of the coefficient of evection in ecliptic longitude was 4585''.978. This having been multiplied by 1.0001544, we have Hansen's actual tabular value, 4586''.68. The correct theoretical value depends on the eccentricity. Using the value of this element as corrected by Cowell from observations, we shall have:

	''
Theory of Hansen's Darlegung	$4586.42 \sin (2D-g)$
Theory of Delaunay	$4586.30 \sin (2D-g)$
Theory of Brown	$4586.42 \sin (2D-g)$
Action of planets	$+0.04 \sin (2D-g)$

In "Action II" a correction of $+0''.036$ is derived from the action of the planets. The definitive correction to Hansen's Tables for this term is therefore

$$\delta l = -0''.22 \sin (2D-g).$$

Miscellaneous Terms.

21. The preceding terms of short period are mostly large ones which require special adjustments to the revised values of the elements. The question now arises whether there are other solar terms which require important correction to reduce them to Brown's theory. An examination of Brown's comparison of his results with those of Hansen[a] shows only the following terms to be corrected:

	$''$
Hansen (tables)	$\delta l = +206.49 \sin (g-3g'+2\pi-2\pi')$
Delaunay	$\delta l = +206.34 \sin (g-3g'+2\pi-2\pi')$
Brown	$\delta l = +206.22 \sin (g-3g'+2\pi-2\pi')$
Hansen (tables)	$\delta l = -\ 1.54 \sin (\pi-\pi')$
Hansen (Darlegung)	$\delta l = -\ 1.33 \sin (\pi-\pi')$
Delaunay	$\delta l = -\ 0.87 \sin (\pi-\pi')$
Brown	$\delta l = -\ 1.09 \sin (\pi-\pi')$

Here π' is the longitude of the solar perigee. When the earth's perihelion is used the sign is to be changed. The corrections in question thus become

$$\begin{aligned} \delta l = &- 0''.27 \sin (g-3g'+2\pi-2\pi') \\ &+ 0''.45 \sin (\pi-\pi'). \end{aligned}$$

The last of these may be classified with the terms of mean period, which will be tabulated as a function of the time.

Hill has also a term arising from the ellipticity of the earth,

$$\delta l = 0''.390 \sin (2g+2\pi-\Omega),$$

as to the use of which I am in doubt. Its shortness of period renders it unnecessary to take account of it.

Erroneously Tabulated Term.

There is yet another correction of short period, related to the reduction to the ecliptic, which is to be applied to the positions of the moon given in the ephemerides from 1862 to 1882, and which arises in the following way: Hansen found, in his theory, a term

$$\delta l = -0''.335 \sin (2g-4g'+2\omega-4\omega')$$

which he includes in Table XXXIV as an inequality of $n\delta z$, but which he accidentally used with the positive sign. In the Darlegung he found a coefficient of $0''.285$. Hence the tables require the correction

$$\delta l = 0''.62 \sin (2g-4g'+2\omega-4\omega')$$

A revised Table XXXIV, in which this correction was incorporated, was printed and circulated by the office of the American Ephemeris in 1878, and used in the national ephemerides from 1883. It was also used in the present work from the beginning till 1861.

Correction of the Perigee.

22. When the tables for the preceding corrections were prepared it was supposed that the error of the moon's perigee was so small that it was not necessary to introduce any correction as pre-

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[a] Monthly Notices, R. A. S., Vol. LXV, pp. 276–296, January, 1905.

liminary to the equation, but the researches of Cowell seem to show the advisability of introducing this correction in advance. He applies to Hansen's perigee the preliminary correction

$$\delta\pi = -4''.63 + 13''.99T - 4''.74T^2 \ (1800).$$

To this he finds from a general discussion of the early and later Greenwich observations the correction

$$\delta\pi = -2''.9 - 1''.0T + 7''.4T^2,$$

making the total correction to Hansen's longitude of the perigee

$$\delta\pi = -7''.5 + 13''.0T + 2''.7T^2. \qquad (22)$$

The term in T^2 has a well determined theoretical value best derived from Brown's expressions, from which we obtain the following results:

	''
Sidereal term	$-38.13T^2$
Equinoctial term	$+\ 1.11T^2$
Total	$-37.02T^2$
Hansen's term	$-36.19T^2$
Actual correction	$-\ 0.83T^2$
Correction to Cowell	$-\ 3.5T^2$

The coefficients have all been reduced to 1850, from which epoch T is reckoned.

This correction will have a material influence upon the motion to be derived from the observations, the amount of which depends upon the epoch at which Cowell's coefficient of T has the maximum weight. I assume this epoch to be 1875.

By differentiating (22) we find that the correction to Hansen's centennial motion found by Cowell has the general form

$$D_t\delta\pi = +13''.0 + 5''.4T;$$

T is counted from 1800.0. It follows that the correction to Hansen's centennial motion found by Cowell for this epoch is + 17''.0 at the epoch 1875. By differentiating the correction $-0''.83T^2$ found by theory, we find that in order to produce the preceding value for 1875 the general form of the correction is

$$D_t\delta\pi = 18''.2 - 1''.66T,$$

and the actual correction to the longitude of the perigee as it results from Cowell's work may be taken as

$$\delta\pi = -9''.4 + 18''.2T - 0''.83T^2.$$

The values for special epochs are as follows:

Year.	$\delta\pi$	$2e\delta\pi$
	''	''
1675	−33.4	−3.7
1700	−28.4	−3.1
1750	−18.7	−2.1
1800	− 9.4	−1.0
1850	− 0.5	−0.1
1900	+ 8.0	+0.9

This correction is so large that I have tested it by a rough least-square solution of the 66 good equations of condition found in Researches, pages 226–230, which lead to the result

$$\textit{circa}\ 1700; \quad \delta\pi = +8'' \pm 7''.$$

This is so incompatible with Cowell's result that I apply no preliminary correction to π.

Correction of the Eccentricity.

The correction to the coefficient of the equation of the center found by the author[a] is

$$2\delta e = -0''.57.$$

In deriving this result I overlooked a point recently brought out by Cowell, that the unequal distribution of the observations through a lunation will lead to an error in δe in case the tabular terms depending on $D+g$ and $D-g$ are incorrect. From Cowell's work it would seem that the correction $2\delta e$ is about $-0''.65$. Battermann, in two important researches, to be discussed later, has found from occultations a seemingly much larger value of the negative correction, namely

$$1884.3-1885.7;\ 2\delta e = -1''.10.$$
$$1894.8-1897.0;\ 2\delta e = -0''.90.$$

But an examination of the table of mean-period inequalities of $2\delta e$, or of h, shows that these are in good agreement with Cowell's mean correction.

	1884–1885.	1894–1897.
	$''$	$''$
Inequality of $2\delta e = h$	−0.45	−0.33
Cowell's constant	−0.65	−0.65
Apparent correction	−1.10	−0.98

As these provisional corrections are not intended as the basis of a theory, but only to bring the tables into as near an accord with observations as is practicable, I have accepted Cowell's result,

$$\delta l = -0''.65 \sin g,$$

as a correction to Hansen's tabular ecliptic longitude.

SECTION II.—CORRECTIONS TO THE LATITUDE, SEMIDIAMETER, AND PARALLAX.

The Latitude.

23. The most important deviation of Hansen's tabular latitude from pure theory consists in the constant correction of $-1''.00$ to the latitude on account of a supposed noncoincidence of the centers of gravity and figure of the moon. It seems probable that the seeming necessity for this correction arose partly because Hansen used too small a value of the moon's parallax, and partly from systematic errors in the observations of declination with which his comparisons were made. Owing to the serious doubt which may be entertained of the reality of the correction, it seems advisable to take it out, leaving the question involved in it for determination by equations of condition. This course is the more advisable from the correction being so easily made. We shall therefore apply to the provisional comparisons the constant correction

$$\delta\beta = +1''.0.$$

In "Action II," section 67, page 138, I have found the following terms in the combined effect of the motion of the ecliptic and the action of the planets upon the moon's node and inclination:

$$\delta\text{☊} = +(2''.55-0''.24T)\sin\text{☊}-(17''.33+0''.01T)\cos\text{☊},$$
$$\delta i = -(0''.228-0''.022T)\cos\text{☊}-(1''.538+0''.002T)\sin\text{☊},$$

T being reckoned from 1800. These give the inequality of the latitude

$$\delta\beta = -(0''.228-0''.022T)\sin v + (1''.546+0''.002T)\cos v,$$

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[a] Astronomical Papers of the American Ephemeris, Vol. I, p. 69.

v being the true longitude in orbit of the moon. The argument v is also that of a term due to the ellipticity of the earth of which Hill's value is equivalent to

$$\delta\beta = -8''.726 \sin v.$$

Applying to this the terms just found we have as a result of theory,

$$\begin{aligned}\delta\beta = &- 8''.954 \sin v + 1''.546 \cos v \\ &+ (0''.022 \sin v + 0''.002 \cos v)T.\end{aligned}$$

The corresponding term in Hansen's tables is

$$\begin{aligned}\delta\beta &= +8''.764 \sin (v + 169^\circ\ 51') \\ &= -8''.627 \sin v + 1''.544 \cos v.\end{aligned}$$

Thus the theoretical correction to the tabular latitude is

$$\delta\beta = -(0''.327 - 0''.022T) \sin v;$$

but the correction is doubtful by its entire amount owing to the uncertainty of Hill's value of the earth's radius of gyration, and need not be considered until after the comparison with observations. Its effect on the moon's declination is practically the same as that of a correction to the tabular obliquity of the ecliptic.

Hansen cites, but does not tabulate, a secular variation equivalent to

$$\delta\beta = +0''.039T \sin v + 0''.005T \cos v,$$

which is nearly twice as great as that given above. The latter is too small to demand consideration in the present connection.

Cowell finds a correction of $-0''.30$ to Hansen's inclination.[a] This is presumptively real, but it is not necessary to apply it in the present work.

As to the value of $\delta\beta$ to be used, we remark that the only correction which we apply in advance to the ecliptic latitude is

$$\delta\beta = +1'' + \sin i \cos (v - \Omega)\delta l.$$

When we use m' the second term of this expression is unnecessary, its effect being included in the correction Δv. The preliminary correction of β actually required is the constant $+1''$ simply. This is in strictness applicable only to the ecliptic latitude, because it is from this latitude that Hansen's tables subtract the constant. But it may without appreciable error be applied in the direction at right angles to the plane of the orbit, and therefore used for $\delta\beta'$.

The correction of D for the obliquity may be easily computed by using the coefficient of $\Delta\epsilon$ in the equations of condition. But as we shall hereafter find it convenient to compute separate values of $\Delta\epsilon$ for various groups of the equations of condition, this correction may in most cases be omitted and applied to the respective values of $\Delta\epsilon$ formed from the groups of equations.

The Moon's Semidiameter.

24. From a consideration of the work of J. Peters,[b] L. Struve,[c] and H. Batterman,[d] I have adopted as the best value of the semidiameter

$$s_0 = 932''.58.$$

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[a] Monthly Notices, R. A. S. Vol. LXV, p. 564, April, 1905.

[b] Ast. Nach. CXXXVIII, S. 147.

[c] Ast. Nach. CXXXV, S. 175.

[d] Beobachtungs-Ergebnisse der Königlichen Sternwarte zu Berlin, Hefte Nr. 5 und 11.

In the original work the geocentric semidiameter was computed from

$$s=[4.75002]\ \sin\pi,$$

giving, for the constant of $\sin\pi=3422''.07$, $\log\sin\pi_0=8.21986$;

$$s_0=933''.00.$$

The adopted semidiameter therefore requires the correction

$$\delta s_0=-0''.42.$$

which may be taken as constant.

Hansen uses $s_0=934''.08$, correction $=-1''.50$. At Greenwich since 1900 a correction of $-1''.43$ has been applied to Hansen's value, leaving a subsidiary correction of $-0''.07$.

With Hansen's parallax and $s_0=932''.58$, we have for the geocentric semidiameter

$$s=[4.74982]\ \sin\pi.$$

But if we increase Hansen's parallax by $0''.40$, a correction given by theory, we have

$$s=[4.74977]\ \sin\pi.$$

The Parallax.

25. The preceding corrections being geocentric, it is now necessary to consider, in addition to them, those of the moon's parallax. We have at the base of these corrections a system of connected quantities requiring a careful study of their relations in order to determine what form of correction for parallax is best. These are the dimensions of the geoid, its compression, the difference between the astronomical and geometrical latitude of the point of observation, which we may regard as the deviation of the plumb line at the point, the intensity of gravity, and the parallax of the moon, which it is common to refer to the earth's equatorial radius.

Whether, in the present investigation, it will be profitable to attempt the determination of any of these quantities from the occultations can be settled only after the latter are discussed. Whatever the decision on this point, it is sufficient to our present purpose to reduce all the apparent positions of the moon to the best attainable value of the quantities growing out of the parallax of the moon.

Let us first consider local deviations of the plumb line. In astronomical investigations it has always been tacitly assumed that the geographic and the astronomical terrestrial longitudes of the station are identical. This can be the case only when the direction of the plumb line intersects the earth's axis of rotation. Since local deviations in the direction of gravity are as likely to affect the longitude as the latitude, the two effects are equally worthy of study. Using round numbers, the maximum change in the direction of the moon caused by such a deviation is about one-sixtieth of the change in the geocentric position of the observer; in other words, $1'$ of deviation of the plumb line will correspond to a maximum error of less than $1''$ in the position of the moon, and therefore to an average error yet smaller. Since the deviations amount only to a very few seconds, except in mountainous regions, it follows that the error thus produced in the positions of the moon may be neglected, and that we may adhere to the theory of the ellipsoidal figure of the geoid in all discussions of the observations of the moon having an astronomical and not a geodetic purpose.

We must still use the best attainable value of the compression of the geoid, and it will then be a question whether a new determination of the compression can be inferred from the occultations. Professor Battermann in the discussion of the second series of his occultations has taken an important step in this direction by introducing into his equation two unknown quantities which depend upon the parallax and the compression. Whether it is practicable to utilize the work in this way remains to be seen.

A defect in astronomical practice consists in taking the equatorial radius of the earth as the fundamental length to which the moon's parallax is referred. As a matter of fact, the mean radius, for which we may take indifferently the mean of the three axes, or the radius at mean latitude, where $\sin^2\varphi' = \frac{1}{3}$, should be, in theory at least, adopted as the radius of reference. It is practically this radius which is best determined by geodetic measurements, and for which the intensity of gravity can best be ascertained through observations of the pendulum. Accepting this, we have first to consider the error to which the parallax of the moon referred to this radius is liable when determined from gravitational theory. This method rests on the equation

$$a^3n^2 = M + m,$$

M and m being the respective masses of the earth and moon in gravitational units; a the moon's mean distance and n its mean sidereal motion in the unit of time. The value of M is derived from pendulum observations. When the formulæ are reduced to their most concise form we find that the equation which gives π_1, the mean parallax of the moon, in terms of l_1, the length of the seconds pendulum at mean latitude, and ρ_1, the mean radius of the earth, is of the form

$$\pi_1^3 = K\frac{\rho_1}{l_1},$$

K being a constant of which the value is known with all necessary precision. We may regard the mean radius of the geoid, as determined from geodetic measures, to be accurate within a few hundred meters, say 0.00005 of its whole amount. This proportional error would imply an error of more than 318 meters in the determination, which seems to be the probable limit. The proportional error of l_1 must, I suppose, be smaller than this. The proportional error in π_1 being only one-third of that in ρ_1 and l_1, the maximum error which we have to fear in this quantity can scarcely be much greater than

$$\pm 0.000025\pi_1 = \pm 0''.09.$$

As we can not hope to detect so small an error as this from observations of the moon, we may regard the parallax of the latter, referred to the mean radius of the earth, as a known quantity not subject to correction. It follows that the only quantity which remains so subject will be the compression of the geoid. We have, therefore, to express the parallactic corrections in terms of the compression. Putting

ρ_1, the mean radius of the earth;
α, the compression;

the radius in latitude φ' is, when all powers of α above the first are neglected,

$$\rho = \rho_1[1 + \alpha(\tfrac{1}{3} - \sin^2\varphi')]. \qquad (23)$$

The author has published computations of the constant of the moon's parallax from gravitational theory first in "Elements and Constants,"[a] and then in the Encyclopædia Britannica, supplement to the ninth edition. It seems desirable to repeat the computation from the most recent data bearing on the result. I am indebted to Professor Helmert for the following numbers expressing the most probable form and dimensions of the geoid from all data at present available. Along with them are given for comparison the numbers of Clarke, Bessel, and Listing:

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[a] The Elements of the Four Inner Planets and the Fundamental Constants of Astronomy.

	a	b	ρ_1	α
Helmert	6377980	6356596	6370843	1÷298.26
Clarke	6378249	6356515	6370997	1÷293.46
Bessel	6377397	6356079	6370282	1÷299.15
Listing	....	....	....	1÷288.48
H−C	−269	+81	−154	....
H−B	+583	+517	+561	....

The length of the seconds pendulum derived by Helmert[a] is

$$L=0^{\text{m}}.990918\ (1+0.005310 \sin^2\varphi),$$

from which follows for the force of gravity, affected by centrifugal force,

$$g=9^{\text{m}}.77997\ (1+0.005310 \sin^2\varphi).$$

The expression for the centrifugal force is

$$\Delta g=0^{\text{m}}.03392\ \rho \cos\varphi' \cos\varphi.$$

At mean latitude ($\sin^2\varphi'=\frac{1}{3}$) these data give

	m
Apparent gravity	9.79743
Centrifugal force	0.02253
Actual gravity	9.81996

I adopt from "Elements and Constants," page 193,

$$\text{Mass of moon: Mass of earth}=1:81.45,$$

and from page 194,

$$\text{Motion of moon in a Julian century, } 1336.85 \text{ rev.},$$

giving for motion in arc in one second of time

$$\log n=4.425159-10.$$

Proceeding as in Elements and Constants, section 97, we find that when any radius ρ of the earth is expressed in meters, the corresponding horizontal parallax π of the moon is given by the equation

$$\sin\pi=[1.415232-10]\rho.$$

Hence, for the mean radius ρ_1,

$$\log\sin\pi_1=8.219429,$$

or expressed in seconds,

$$\sin\pi_1''=3418''.65.$$

For the constant of the sine of the equatorial horizontal parallax we then have

$$\sin\pi_0''=3418''.65\ (1+\tfrac{1}{3}\alpha). \tag{24}$$

The transformation of Hansen's parallax shows, that in his tables,[b]

$$\sin\pi_0''=3422''.07.$$

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[a] Höheren Geodäsie, II, p. 241.

[b] Astronomical Papers of the American Ephemeris, Vol. I, Part II.

Using the parallax of Hansen's tables, and a compression α_0, the adopted constant of the sine of the horizontal parallax at latitude φ' will be equivalent to

$$3422''.07\ (1-\alpha_0 \sin^2\varphi'), \tag{25}$$

while the value found above is

$$3418''.65\ [1+\alpha\ (1/3-\sin^2\varphi')], \tag{26}$$

α being the true value of the compression, which appears in the equation as an indeterminate quantity. The difference between these last two expressions will be the symbolic correction to the adopted parallax, practically that of Hansen's tables. Putting

$$\delta\alpha=\alpha-\alpha_0,$$

the correction of the adopted compression, the total correction of the local horizontal parallax, or of $\rho \sin \pi_0$ is, with all necessary precision,

$$\varDelta(\rho \sin \pi_0)=-3''.42+1140''\ \alpha + \sin^2\varphi'\ (3''.42\ \alpha_0-3419''\ \delta\alpha). \tag{27}$$

26. Our next step will be to express the corrections to the adopted parallaxes in longitude and latitude. For this purpose approximate expressions for the parallaxes themselves will suffice. Using the notation of §6, put

π, the horizontal parallax for the arbitrary unit-radius;
ρ, the radius of the earth for the place;
π_l, the parallax in longitude;
π_b, the parallax in latitude;

neglecting quantities of the second order as to the latitude and parallax, we shall have

$$\pi_l=\rho \sin \pi \cos \beta \sin (l-\lambda), \tag{28}$$

where β and λ are the coordinates of the observer. Substituting for $\cos \beta \cos \lambda$, and $\cos \beta \sin \lambda$, their values in terms of equatorial coordinates, and τ the sidereal time, namely

$$\left.\begin{aligned} \cos \beta \cos \lambda &= \cos \varphi' \cos \tau, \\ \cos \beta \sin \lambda &= \cos \varphi' \sin \tau \cos \varepsilon+\sin \varphi' \sin \varepsilon, \end{aligned}\right\} \tag{29}$$

to which we add for reference

$$\sin \beta=\sin \varphi' \cos \varepsilon-\cos \varphi' \sin \varepsilon \sin \tau,$$

we shall have

$$\begin{aligned} \pi_l=&\rho \cos \varphi' \sin \pi\ [\cos^2 \tfrac{1}{2}\varepsilon \sin (l-\tau)+\sin^2 \tfrac{1}{2}\varepsilon \sin (l+\tau)] \\ &-\rho \sin \varphi' \sin \pi \sin \varepsilon \cos l. \end{aligned}$$

The last term of the first line is quite small and is also without systematic effect upon the result; we may therefore omit it. The original expression (28) for π_l is too small by a factor having the average value of 0.01. We may therefore put for our immediate purpose

$$\begin{aligned} \pi_l=&+0.97\ \rho \cos \varphi' \sin \pi \sin (l-\tau) \\ &-0.40\ \rho \sin \varphi' \sin \pi \cos l. \end{aligned}$$

Putting

r, the geocentric distance of the moon in terms of the unit radius of the earth;

r', the distance of the moon from the observer;

the apparent latitude b' is given by the equation

$$r' \sin b' = r \sin b - r\rho \sin \pi \sin \beta,$$

or, since $r \sin \pi = 1$,

$$r' \sin b' = r \sin b - \rho \sin \beta.$$

Putting $\varDelta r = r' - r$, and $\cos b = 1$, we have

$$\begin{aligned} b' &= b + \pi_b, \\ r' &= r + \varDelta r, \end{aligned}$$

then, neglecting quantities of the second order as to the parallax,

$$\pi_b = b' - b = -\frac{\rho}{r} \sin \beta - \frac{\varDelta r}{r} \sin b.$$

The maximum range of $\sin b$ is between the limits ± 0.09 and, being as often positive as negative, its systematic effect as a factor of $\varDelta r$ will be insensible. We may therefore drop it entirely. Putting as before, $\sin \pi$ for $1 : r$, we shall now have

$$\pi_b = -\rho \sin \pi \sin \beta.$$

Putting for $\sin \beta$ its value as already given, and replacing $\sin \varepsilon$ and $\cos \varepsilon$ by their numerical values, gives

$$\pi_b = -0.92\, \rho \sin \varphi' \sin \pi + 0.40\, \rho \cos \varphi' \sin \pi \sin \tau.$$

The compression which I shall use as definitive in the present work is that of Helmert, as privately communicated,

$$a = 1 : 298.2 = 0.003353.$$

This gives, from (24), for the constant of the sine of the equatorial horizontal parallax

$$\sin \pi_0'' = 3422''.47,$$

showing a correction of $+0''.40$ to the Hansenian value. The correction of the actual parallax at any place will depend also on the adopted compression. Taking the earth's equatorial radius as unity we have, approximately,

$$\begin{aligned} \rho \sin \varphi' &= (1 - 2a) \sin \varphi + a \sin^3 \varphi, \\ \rho \cos \varphi' &= \cos \varphi\, (1 + a \sin^2 \varphi). \end{aligned}$$

It follows that the corrections of these coordinates for the compression are

$$\left.\begin{aligned} \varDelta(\rho \sin \varphi') &= -2\delta a \sin \varphi + \delta a \sin^3 \varphi, \\ \varDelta(\rho \cos \varphi') &= +\delta a \sin^2 \varphi \cos \varphi. \end{aligned}\right\} \qquad (30)$$

Three values of a have been used in the course of the reductions, those of Bessel, Clarke, and Listing:

Bessel	$a_0 = 1 : 299.15 = .003343$	$\therefore\ \delta a = +.000010$
Clarke	$a_0 = 1 : 293.46 = .003408$	$\delta a = -.000055$
Listing	$a_0 = 1 : 288.48 = .003466$	$\delta a = -.000113$

We use the notation

$$h' = \rho \sin \varphi' \sin \pi,$$
$$k' = \rho \cos \varphi' \sin \pi.$$

Disregarding negligible quantities, we have the corrections

$$\Delta h' = \sin \pi \, \Delta(\rho \sin \varphi') + \sin \varphi \, \delta\pi,$$
$$\Delta k' = \sin \pi \, \Delta(\rho \cos \varphi') + \cos \varphi \, \delta\pi.$$

From (30) and $\delta\pi = +0''.40$, we now have

$$\Delta h' = (0''.40 - 2\,\delta\alpha \sin \pi) \sin \varphi + \delta\alpha \sin \pi \sin^3\varphi,$$
$$\Delta k' = 0''.40 \cos \varphi + \delta\alpha \sin \pi \cos \varphi \sin^2\varphi.$$

From the three values of $\delta\alpha$ given above we have the following results:

When Bessel's compression has been used:

$$\Delta h' = +0''.33 \sin \varphi + 0''.03 \sin^3\varphi,$$
$$\Delta k' = +0''.40 \cos \varphi + 0''.03 \cos \varphi \sin^2\varphi.$$

When Clarke's compression has been used:

$$\Delta h' = +0''.78 \sin \varphi - 0''.19 \sin^3\varphi,$$
$$\Delta k' = +0''.40 \cos \varphi - 0''.19 \cos \varphi \sin^2\varphi.$$

When Listing's compression has been used:

$$\Delta h' = +1''.17 \sin \varphi - 0''.39 \sin^3\varphi,$$
$$\Delta k' = +0''.40 \cos \varphi - 0''.39 \cos \varphi \sin^2\varphi.$$

In all cases the corrections to the apparent longitude and latitude of the moon are

$$\Delta l' = +0.97\,\delta k' \sin (l - \tau) - 0.40\,\delta h' \cos l,$$
$$\Delta b' = +0.40\,\delta k' \sin \tau - 0.92\,\delta h'.$$

To the equatorial coordinates the corrections are

$$\cos \delta \, \Delta\alpha = -\delta k' \sin (\tau - \alpha),$$
$$\Delta\delta = -\delta h' \cos \delta + \delta k' \sin \delta \cos (\tau - \alpha).$$

SECTION III.—RECAPITULATION OF THEORETICAL CORRECTIONS TO THE GEOCENTRIC POSITION OF THE MOON GIVEN BY HANSEN'S TABLES.

Corrections to the Longitude and Latitude.

27. (A) *To the mean longitude.*—These are the secular and long-period corrections expressed in §15 and tabulated on page 30.

(B) *To the true longitude.*—These are expressed in the form

$$\delta l + h \sin g + k \cos g.$$

In the following expressions the constituents π, g', J, M, and V are reckoned from the earth's perihelion of 1800 ($\pi' = 99^\circ.5$ for the equinox of 1800, or $100^\circ.2$ for that of 1850). t is expressed in Julian years counting from 1850.0:

Terms of Mean Period.	*Argument.*
$''$	$^\circ \qquad ^\circ$
$\delta l = +0.38 \sin (\Omega + 73^\circ.6)$	$320.8 + 19.3415t^{a}$
$+0.26 \sin (2\pi - 2\mathrm{J})$	$239.8 + 20.655t$
$+0.26 \sin (2\pi - 3\mathrm{J} + 268^\circ.2)$	$92.4 + 9.694t^{a}$
$+0.18 \sin (\mathrm{J} + 22^\circ.5)$	$82.2 + 30.349t$
$+0.05 \sin (2\mathrm{M} - g' + 329^\circ)$	$295.2 + 22.812t$
$+0.07 \sin (2\pi + 3\mathrm{V} - 5g')$	$72.6 + 36.947t$
$-0.45 \sin \pi$	$179.5 + 40.673t$
$+0.13 \sin (g + 2\pi - 20\mathrm{V} + 19g' + 13^\circ)$	$147.2 + 10.340t^{a}$
$+0.11 \sin (g - 26\mathrm{V} + 29g' + 51^\circ)$	$255.0 + 2.826t^{a}$
$h = -0.65$	
$-1.15 \cos (2\pi - 2\mathrm{J})$	$239.8 + 20.655t$
$+0.44 \cos (2\pi - 3\mathrm{J} + 268^\circ.0)$	$92.6 + 9.694t^{a}$
$-0.65 \cos (2\pi + 3\mathrm{V} - 5g')$	$72.6 + 36.947t$
$k = +0.13\mathrm{T}^2$	
$-1.15 \sin (2\pi - 2\mathrm{J})$	$239.8 + 20.655t$
$+0.44 \sin (2\pi - 3\mathrm{J} + 268^\circ.0)$	$92.6 + 9.694t^{a}$
$-0.65 \sin (2\pi + 3\mathrm{V} - 5g')$	$72.6 + 36.947t$
$+0.45 \sin (\Omega - 11^\circ.3)$	$45.1 + 19.341t^{a}$

Terms of Short Period.

$$
\begin{aligned}
\delta l = &+ \overset{''}{0.22} \sin \mathrm{L} \qquad\qquad [\mathrm{L} = \mathrm{V} - \mathrm{E} = \mathrm{V} - g'] \\
&+ 0.35 \sin (2\mathrm{L} - g' + 164^\circ.3) \\
&+ 0.20 \sin (3\mathrm{L} - g' + 168^\circ.3) \\
&+ 1.60 \sin \mathrm{D} \\
&- 0.15 \sin (\mathrm{D} + g') \\
&+ 0.59 \sin (\mathrm{D} - g) \\
&+ 0.10 \sin (\mathrm{D} + g) \\
&+ 0.23 \sin g' \\
&- 0.21 \sin 2\mathrm{D} \\
&- 0.22 \sin (2\mathrm{D} - g) \\
&- 0.27 \sin (g - 3g' + 2\pi) \\
&- 0.23 \sin (g + 2\pi - 3g' + \mathrm{J}) \\
&+ 0.19 \sin (2\mathrm{J} - g' + 342^\circ) \\
&- 0.17 \sin (g + 2\pi - 2\mathrm{V}) \\
&+ 0.17 \sin (g - \mathrm{V} + g') \\
&- 0.15 \sin (g + \mathrm{V} - g') \\
&+ 0.15 \sin (g + 2\pi - \mathrm{V} - g') \\
&+ 0.14 \sin (g + 2\pi + 2\mathrm{V} - 4g') \\
&+ 0.14 \sin (g + g' - \mathrm{J}) \\
&- 0.16 \sin (g - g' + \mathrm{J}) \\
&- 0.17 \sin (2g + 2\pi - 3g' + \mathrm{J}) \\
&- 0.14 \sin (2g + 2\pi - 2\mathrm{V}).
\end{aligned}
$$

---

[a] In these terms the supplement of the argument is used in order to make the motion positive. The third term of h thus becomes $-0''.44 \cos$ Arg.

Exceptional Term (1862–1882).

$$\delta l = \overset{-?}{\cancel{+}}\, 0''.62 \sin (2g - 4g' + 2\omega - 4\omega').$$

(C) *To the latitude.*—This takes the form

$$\delta\beta = +1''.00 + \sin i \cos (v - \Omega)\, \delta l,$$

where v is the moon's true longitude in orbit.

The preceding corrections were computed and tabulated for all the dates of observation with results found in Chapter V. As it is the author's intention to issue improved tables based on the definitive results of the work, it seems unnecessary to publish the preliminary tables.

The corrections to the position of the star, if necessary, are to be found, and need not be considered here.

With the corrected apparent coordinates of the moon and star, we may now compute the value of D for the corrected provisional theory by the formulæ of §§ 8 or 9. But since nearly all the occultations to be used have been reduced in some form, we may generally find a correction to D by the formulæ of § 10.

Corrections to the Right Ascension and Declination.

28. As longitudes and latitudes alone were used up to 1861 in the independent reductions, no corrections to the equatorial coordinates need be considered before that year. But after 1861, and in some earlier cases when published reductions are used, it may be desirable to transform the corrections of the ecliptical system into those of the equatorial system. This requires that we also consider the correction to the obliquity of the ecliptic.

In most of the reductions the R. A. and Decl. of the moon are taken from the British Nautical Almanac. Here the obliquity of Bessel's Tabulæ Regiomontanæ was used from 1835 until 1862, and that of Leverrier from 1863 until 1900. The reduction to that of Newcomb's Tables is found as follows:

Bessel	$\varepsilon = 23^\circ\ 27'\ 31''.95 - 0''.457t$
Leverrier	$\varepsilon = 23^\circ\ 27'\ 31''.83 - 0''.4759t$
Newcomb	$\varepsilon = 23^\circ\ 27'\ 31''.68 - 0''.4684t$

Reduction of Bessel	$\delta\varepsilon = -0''.27 - 0''.0114t$
Reduction of Leverrier	$\delta\varepsilon = -0''.15 + 0''.0075t$

where t is counted in years from 1850. The corrections for decennial epochs are as follows:

Reduction of the Obliquity.

Bessel.		Leverrier.	
Year.	$\Delta\varepsilon$	Year.	$\Delta\varepsilon$
	$''$		$''$
1830	−0.04	1860	−0.08
1840	−0.16	1870	0.00
1850	−0.27	1880	+0.08
1860	−0.38	1890	+0.15
1870	−0.50	1900	+0.23

The corrections of the longitude, latitude, and obliquity may be transformed to those of R. A. and Decl. by well known formulæ. The coefficients of the transformation of δl and δb are tabulated in the author's work of 1876, Investigation of Corrections to Hansen's Tables of the Moon, etc., and also in his Compendium of Spherical Astronomy, Appendix, Table XXI. But instead of computing $\Delta\alpha$ and $\Delta\delta$, he has generally preferred to compute at once the correction to D. In doing this we remark that the small corrections of short period of which we have given the expressions may be applied indifferently to the longitude in orbit or to the ecliptic longitude. But the secular corrections and those of long period are applicable to the longitude in orbit. The correction to the distance of the moon and star may therefore in most cases be most conveniently computed by the equation (13) of §10.

CHAPTER IV.

DATA RELATING TO STATIONS AND ORIGINAL OBSERVATIONS.

29. The great majority of the observations have been taken from published sources so well known and generally accessible that it does not seem necessary to cite the original times of the occultations in detail. The requisite original data for each occultation are the position of the station and the mean time at which the occultation was observed. There are, however, a few cases in which the positions of the station had to be specially investigated, and other cases in which the mean time had to be computed. In these cases some details of the work may be useful, as may also be some statements respecting the sources and the use made of them.

All the observations before 1750 being fully discussed in the Researches of 1878, the present statement refers only to the period since 1750.

The Greenwich observations during the time of Bradley, Bliss, and Maskeleyn are found in the published volumes, mostly scattered in their proper chronological order among the meridian observations. Generally, the apparent time of the occultation is given, making necessary the application of the equation of time.

The Paris observations for 1801 and a few following years are found in the regular volumes published by Arago.

The richest of all the sources is the Astronomische Nachrichten, most of the volumes of which contain observations of occultations.

Some other sources are: Memoirs and Monthly Notices of the Royal Astronomical Society; The Astronomical Journal; Sternbedeckungen und Mondsterne beobachtet auf der K. K. Sternwarte in Krakau, herausgegeben von Dr. Max. Weisse, director, Krakau, 1855; Bestimmungen des Monddurchmessers aus Neun Plejadenbedeckungen des Zeitraumes 1839 bis 1876, mit gleichzeitiger Ermittlung der Oerter des Mondes. (Inaugral-Dissertation der mathematischen und naturwissenschaftlichen Facultät der Kaiser-Wilhelms-Universität Strassburg zur Erlangung der Doctorwürde vorgelegt von Friedrich Küstner aus Görlitz, Halle, 1880.) Beobachtungs-Ergebnisse der Koniglichen Sternwarte zu Berlin, Hefte 5, 11, und 13, von Dr. H. Battermann, 1891–1910. Observations made at the [temporary] Naval Observatory, Washington, by Lieut. J. M. Gilliss, U. S. Navy, Washington, 1846.

The regular annual volumes of the Greenwich, Cambridge, Washington, and Radcliffe (Oxford) Observatories need only be mentioned.

Remarks on the Stations and Series of Occultations.

30. *Cambridge, 1791–1831.*—The observations of this series were published by Airy in the Memoirs of the Royal Astronomical Society, Volume XXII. They are of much value, owing to their early date. An undue number of them are, however, discordant to an extent that can be accounted for only by errors in the times as published, which probably correspond to the times recorded. The most notable examples of those among the earlier observations are given by the occultation of α Tauri on March 27, 1792, and θ Libræ on April 9, both of which are wrong by several minutes. All the observations of 1812 are discordant by corresponding amounts, though the clock determinations appear good.

The longitude given by Airy for the observatory of St. Johns is $28^s.64$ E., but I actually used $27^s.9$—for what reason I can not now say.

Habana.—A valuable series by Don Ferrer is found in the Memoirs of the Royal Astronomical Society, Volume IV. Don Ferrer gives the latitude of his observatory as 23° 8′ 17″.5 and states that it is 23″.6 east of the tower of Morro Castle.

Harkness determined a station

$$\varphi = 23^\circ \ 8' \ 3''.0,$$
$$\lambda = 0^h \ 21^m \ 12^s.54,$$

west of Washington, which was 1′ 17″.9 south and $0^s.85$ east of Morro Light;

Hence Morro Light	$\varphi = 23^\circ \ 9' \ 21''$	
	$\lambda = 0^h \ 21^m \ 13^s.39$	west of Washington.
	$\lambda = 5^h \ 29^m \ 25^s.5$	west of Greenwich.
Red. to Ferrer's station	$-1^s.6$	
Ferrer's station	$\lambda = 5^h \ 29^m \ 23^s.9$	
	$\varphi = 23^\circ \ 8' \ 17''.5$	

It is assumed that the tower of Morro Castle = Morro Light.

Dorchester, Mass.—The observations by William C. Bond are found in the Memoirs of the American Academy of Arts and Sciences.

Cracow.—Weisse gives as the position of his observatory

$$\varphi = +50^\circ \ 3' \ 50''.00,$$
$$\lambda = -1^h \ 10^m \ 28^s.41.$$

It may be assumed that this position is the same as that of the modern university observatory, which has been adopted from the ephemerides.

Cape of Good Hope.—The observations, with their complete reduction, are found in the publications of the Cape Observatory. For the reduction of those previous to 1863 the writer supplied the longitudes and latitudes of the moon, as computed from Hansen's tables.

Washington.—There are three principal stations in Washington. The first, the old observatory of Captain Gilliss, at which observations were made during the years 1839–1842, in connection with the Wilkes's exploring expedition. The second is the old Naval Observatory, and the third the new observatory. The observations at the second point began in 1862.

There is also an unpublished series of observations made at a locality known as Wiesner Farm, by two of my assistants, supplied with all the instruments necessary for accurate work, and who were supposed to be quite capable of making good observations. Their probable error is, however, unduly large, and accordingly no use has been made of them.

Leipzig.—There are two stations at which observations were made of which the second is distinguished as Nr. Leipzig.

Strassburg.—Observations were made at both the old and the new university observatories, which are designated in the accompanying list as (1) and (2). They are, however, not distinguished in what follows.

Cobham, England.—The observations made here were communicated by the observer.

Reduction to Geocentric Coordinates.

31. From what has already been remarked (Chapter III, §26), it will be seen that three different values of the compression were used in the earlier reductions, and a fourth, that of Helmert, in the final ones. All the earlier values were reduced to the latter.

The important question whether the actual figure of the geoid is satisfactorily determined from observations of gravity is one as to which the author feels in doubt. It is to be hoped that the recent extended measures of arcs, both of the parallel and of the meridian, will result in settling this question. It is only necessary here to remark that all the older reductions for parallax were reduced to Helmert's compression and to the writer's determination of the constant, as given in Chapter III.

The adopted mean times of the phases observed are, before 1847, generally the same as those for which the positions of the moon are computed, as found in the next chapter.

List of Geographical Positions.

32. The adopted longitudes from Greenwich, the geographic latitudes, and the geocentric coordinates as computed with Helmert's compression are shown in the following table.

The years of observation in the last column are only approximate summary statements, intended to give a general idea of the series used.

Stations and Series of Occultations.

Station.	West Longitude.	Latitude.	ρ sin φ′.	ρ cos φ′.	Period.
	h m s	° ′			
Paris	−0 9 21.0	+48 50.2	9.87461	9.81919	1810–1829
Greenwich	0 0 0.0	+51 28.6	9.89138	9.79526	1753–1814; 1827–1831; 1847–1908
Cambridge, England	−0 0 27.9	+52 12.9	9.89579	9.78816	1791–1831; 1847–1860
Habana	+5 29 23.9	+23 8.3	9.59165	9.96380	1808–1812
Dorpat	−1 46 53.5	+58 22.8	9.92835	9.72062	1812–1826
Dorchester	+4 44 16.2	+42 19.0	9.82590	9.86956	1825–1839
Berlin	−0 53 34.8	+52 30.3	9.89750	9.78532	1826–1846; 1876–1903
Cracow	−1 19 50.3	+50 3.9	9.88261	9.80834	1825–1854
Cape of Good Hope	−1 13 55.0	−33 56.1	9.74436n	9.91936	1834–1907
Washington (1)	+5 8 2.1	+38 53.5	9.79551	9.89174	1839–1842
Washington (2)	+5 8 12.1	+38 53.6	9.79553	9.89173	1862–1884
Washington (3)	+5 8 15.8	+38 55.2	9.79578	9.89157	1906–1908
Cambridge, U. S. (1)	+4 44 27.9	+42 22.2	9.82635	9.86919	1840–1844
Cambridge, U. S. (2)	+4 44 31.0	+42 22.8	9.82643	9.86913	1845–1850
Leiden	−0 17 56.2	+52 9.3	9.89544	9.78874	1857–1872
Radcliffe	+0 5 2.6	+51 45.6	9.89309	9.79256	1862–1876
Göttingen	−0 39 46.3	+51 31.8	9.89171	9.79476	1868–1877; 1887–1895
Kremsmünster	−0 56 31.6	+48 3.4	9.86938	9.82587	1869
Madrid	+0 14 45.1	+40 24.5	9.80947	9.88229	1869
Altona	−0 39 46.2	+53 32.8	9.90347	9.77486	1871
Neuchatel	−0 27 49.9	+47 0.0	9.86201	9.83454	1872
Leipzig	−0 49 34.0	+51 20.1	9.89052	9.79660	1869–1876
Nr. Leipzig	−0 49 29.6	+51 21.8	9.89069	9.79634	1876–1880
Nikolaieff	−2 7 53.8	+46 58.4	9.86180	9.83478	1873–1883
Kiel	−0 40 35.8	+54 20.5	9.90787	9.76660	1876
Strassburg (1)	−0 31 2.5	+48 34.9	9.87290	9.82138	1873–1880
Strassburg (2)	−0 31 4.7	+48 35.0	9.87291	9.82137	1881–1898
Vienna	−1 5 31.7	+48 12.6	9.87039	9.82454	1869–1879
Hamburg	−0 39 53.8	+53 33.1	9.90349	9.77480	1882–1896
Prague	−0 57 40.3	+50 5.3	9.88275	9.80813	1883–1898
Pola	−0 55 23.1	+44 51.8	9.84625	9.85124	1886–1901
Kasan	−3 16 29.0	+55 47.4	9.91558	9.75091	1890–1907
Engelhardt	−3 15 16.5	+55 50.3	9.91583	9.75037	1904–1907
Padua	−0 47 29.2	+45 24.1	9.85033	9.84716	1891–1896
Santiago	+4 42 46.2	−33 26.7	9.73878n	9.92182	1892–1897
Evanston	+5 50 42.3	+42 3.6	9.82375	9.87132	1897–1901
Wilhelmshaven	−0 32 35.2	+53 31.8	9.90338	9.77501	1898–1904
Cobham	+0 1 2.6	+51 19.7	9.89048	9.79667	1902–1904
Utrecht	−0 20 31.0	+52 5.2	9.89503	9.78941	1904–1905
Tokio	−9 18 58.0	+35 39.3	9.76317	9.91034	1905–1906
Jena	−0 46 21.9	+50 56.3	9.88808	9.80033	1905
Königsberg	−1 21 59.0	+54 42.8	9.90989	9.76264	1905–1907

CHAPTER V.

POSITIONS OF THE MOON FROM HANSEN'S TABLES, WITH REDUCTION OF THE LONGITUDES TO THE PROVISIONAL THEORY.

33. The foundation for the whole theory consists in positions of the moon computed from Hansen's tables. The only substantial modification made is in the omission of the nutation. As the effect of this is eliminated in comparing the position of the moon and of the occulted star, the geocentric quantities will remain unchanged if the nutation is omitted from both bodies. In theory the correction for parallax will be slightly altered, but the alteration is too minute to make it worth while to apply a nutation which is substantially eliminated from the final result. Withal it would be necessary, if nutation were retained, to correct that of Hansen for reduction to the value used in the ephemeris of the star. By completely ignoring it these complications are avoided.

When a long series of positions are to be computed the work may be abridged by various devices described in the Researches of 1878, pages 189–195. These are the following:

(A) *Formation of the arguments of single entry.*—Since the arguments are expressed in days, and, small secular terms aside, increase uniformly with the time, all arguments for one epoch may be derived from those for a preceding epoch by the addition of the interval, periods being subtracted when necessary. An indefinite series of arguments may be thus formed, but it is advisable not to jump over long intervals in the series. The correctness of the arguments may be proved by computing the values for the two extreme epochs from the tables and comparing those for the end of the series with the values derived by continuous addition.

(B) *Double-entry arguments.*—As these remain constant throughout each separate period of the fundamental argument g, it is only necessary to form a series of arguments, and add or subtract constants dependent on the intervening periods of g. The device adopted for this process is described in the former work.

(C) *Terms of long period.*—It is of course much easier to compute the values of these terms for intervals of 10 years, or for the beginning of each year, and then interpolate them, than it is to compute each separately. The following table, giving the tabular quantities of long period, is a continuation of that terminating on page 194 of the Researches of 1878.

Here Δg is the sum of Hansen's Venus-terms of long period, as derived from Tables XLI and XLII, arguments 30 and 31, without modification.

The next two columns give the corresponding corrections of arguments 32 and 33.

The last three columns contain data for the correction on account of secular acceleration, as explained on page 191 of the Researches of 1878.

Continuation of Table in Researches of 1878, pages 192–194.

Year.	Δg	Δ_{32}	Δ_{33}	$\frac{d\Delta g}{dt}$	$\frac{d\Delta_{32}}{dt}$	$\frac{d\Delta_{33}}{dt}$
1830	4561	727	675	−20.8	−5.4	−3.6
1831	4421	711	660	−19.7	−5.4	−3.5
1832	4283	694	645	−18.9	−5.4	−3.4
1833	4146	679	631	−17.5	−5.4	−3.4
1834	4012	663	616	−16.4	−5.3	−3.3
1835	3879	648	602	−15.1	−5.3	−3.2
1836	3749	633	588	−14.0	−5.3	−3.1
1837	3621	618	574	−12.6	−5.2	−3.0
1838	3496	603	560	−11.5	−5.2	−3.0
1839	3373	589	547	−10.4	−5.1	−2.9
1840	3252	575	534	− 9.1	−5.0	−2.8
1841	3134	562	522	− 7.7	−4.9	−2.7
1842	3019	548	509	− 6.3	−4.9	−2.6
1843	2907	535	497	− 4.7	−4.8	−2.5
1844	2798	523	486	− 3.3	−4.8	−2.4
1845	2692	510	474	− 2.2	−4.8	−2.3
1846	2588	498	463	− 0.6	−4.7	−2.2
1847	2488	488	453	+ 0.6	−4.7	−2.1
1848	2390	476	442	+ 2.5	−4.6	−2.0
1849	2297	465	432	+ 3.6	−4.5	−1.9
1850	2206	454	422	+ 5.2	−4.4	−1.8
1851	2119	445	413	+ 6.8	−4.3	−1.7
1852	2036	435	404	+ 8.2	−4.2	−1.6
1853	1956	425	395	+ 9.9	−4.2	−1.4
1854	1879	417	387	+11.5	−4.1	−1.3
1855	1806	408	379	+13.2	−3.9	−1.2
1856	1737	400	372	+14.5	−3.8	−1.1
1857	1671	393	365	+16.2	−3.7	−1.0
1858	1609	385	358	+17.8	−3.7	−0.8
1859	1551	379	352	+19.5	−3.6	−0.7
1860	1497	372	346	....	...	...
1870	1175	...	...	....	...	...
1880	1270	...	...	....	...	...

Explanation of Modifications in the Use of Hansen's Tables.

Args. 1–27: No change.

g: Venus-terms (Args. 30–31) are included in *g*.

32–33: The corrections for Venus-terms and the constants of args. 28–29, are alone included in the corrections of args. 32–33. The omitted correction is principally

$$\left\{\begin{matrix}+190\\+177\end{matrix}\;\sin(\theta+184^\circ.7)\right\}.$$

The maximum effect of each omission is about ±0″.16.

Args. 34–50: From Hansen unchanged except omission of 47 and 49.

Args. 47 and 49: Found near middle of fourth column opposite arg. *g*.

Constant is a misnomer here; it is the sum of the numbers in the right-hand column namely:

1. The tables for args. 47 and 49.
2. The interpolation products for the other tables.

Table VII, Arg. 28, const. 500 } Nutation terms: omitted in first computation.
Table IX, Arg. 51, const. 50 }

34. *Example of computation.*—The computation of the tabular positions was made in ruled computing books, the form being that shown in the example appended. As there is no complete check on this part of the work, it was all done in duplicate.

At the top of the page is the number of the date. These numbers do not form a continuous series, because additional sets of observations were added from time to time. In order to reduce the skilled computations necessary to a minimum, the system was adopted of copying the values of the arguments from the original books of arguments into the pages. The second column gives therefore the value of the argument as computed.

To reduce the labor still more to a matter of routine computing and copying, the tabular numbers before interpolation are, in the case of the single-entry arguments, copied from the printed tables, as are also the differences taken from the tables. The product of each difference by the excess of the actual over the tabular argument follows in the next column.

The sums of the non-interpolated numbers plus the sums of these products form the interpolated sum of the terms.

The sum of the differences multiplied by appropriate factors as necessary serves to compute the variation in 0.01 of a day.

The remainder of the computation will be easily made out by anyone familiar with the use of the tables. Each final value of the coordinates is given in duplicate, one result being that of the best of the original computations, the other of the duplicate computations. For example, in date 57 one result for the longitude, that of which the computation is copied was 24° 18′ 44″.71. The result of the duplicate computation was the same in this particular case. In the same way one sum of the variation of the longitude was 7′ 6″.60 and the other was 7′ 6″.71.

It seems unnecessary to repeat the details for the computation of latitude. Anyone mastering the methods of using Hansen's tables will be able to follow the computation.

LONGITUDE AND PARALLAX OF THE MOON, FROM HANSEN'S TABLES.

DATE 57: [1843, Sept. 11].

g		1.25	1.50						
Arg. 1		2.15	2.14						
2		1.91	1.95						
10		0.32	0.32						
×t	43.69	4.38	4.41						
Arg. 1	52.72	2494	2393				Arg. 1	3.701	3.773
2	44.31	1615	1775				2	200	199
3	77.14	3024	2857				3	234	234
4	50.05	3117	3150				4	159	165
5	127.17	1737	1749				5	1.361	1.374
6	71.79	1876	1884				6	102	101
7	78.30	600	538				7	286	323
8	16.07	242	240				8	14	14
9	59.38	565	578				10	577	568
10	10.87	358	390				12	758	804
11	34.88	382	357				14	67	71
12	36.78	146	184				15	149	141
13	11.54	247	242				16	19	19
14	45.20	374	338	′	″		17	16	16
15	31.62	184	187		7.698				
16	11.07	492	490		21.528	32		7.643	7.802
17	1.36	298	300		36.786	33		+.159	
18	38.57	22	22		3.969	37			
19	2.78	92	95		0.018	38			
20	23.76	246	255	52	0.815	42			
21	26.95	246	243		45.89	2			
22	1.91	114	114						
23	16.75	172	172	′	″				
24	13.37	125	132	53	56.71	Sum			
25	2.87	161	164		4.83	Table XXI			
26	6.17	46	46	54	1.54	Parallax			
27	7.63	42	42						
		192	193						
		19209	19130						
		−79							

g		1.3358840	31.05	22
		19182	483.5	111
28	5234.5	10		
29	4516	140	− 3	177
32	20.052049	78103	−737	151
33	18.060313	917013	+728	− 22
34	88.5239	270467	+ 8.6	+ 21
35	182.279	1253	+ 1.5	+ 11
36	140.845	12723	+ 6.0	+ 27
37	23.0271	46273	+ 76	+ 53
38	10.4072	33801	−134	− 96
39	16.8657	1669	+ 18	+ 11
40	25.1547	3906	− 26	− 13
41	0.0690	829	− 12	− 11
42	5.0555	794	− 28	− 15
43	6.1712	2351	+ 35	+ 4
44	4.6028	1930	+ 9	+ 2
45	1.6456	8116	− 16	− 9
46	1.785	7629	− 2	− 1
48	577.0	180		
50	234.1	223	+882	+283
	Constant	−190	−958	−473
		1.4765242	0.99924	

f_0	180.78865	9.99967		+40	X 0.04387 + .68
Δf	7648	4.06901			2.59429
ω	295.20773	9.81452	lgΔz		
f	180.86513	4.06868	lg f′		2.63816
π	203.22427	3.88353	lgΔf		
f+ω	116.07286	164	ω′		
f+π	24.08940	11713	f′		
red. ecl.	21275	111	π′		
	42	11877	f′+ω′		
X × lat. ineq.	435	11824	f′+π′		
Constant	550	25	(red. ecl.)′		
		1	X′		
	24.31242				
		11850			
	° ′ ″	′ ″			
	24 18 44.71	7 6.60	λ′		
	71	71			

LATITUDE OF THE MOON, FROM HANSEN'S TABLES.

DATE 57.

g	1.3359		1.25	1.50		
1	42.66		10.23	10.12		
2	70.36		15.87	16.35		
3	51.08		10.52	10.94		
4	59.49		16.77	16.58		
5	54.36		3.69	3.60		
6	26.51		3.61	3.55		
7	26.81		1.90	1.79		
8	9.74		.80	.80		
9	30.72		2.17	2.15		
10	13.04		.07	.08		
11	7.80		.25	.25		
12	5.22		.92	.90		
13	3.46		1.13	1.12		
14	1.71		.69	.67		
15	19.53		.67	.69		
16	18.94		.39	.39		
17	20.7		.25	.25		
18	9.5		.22	.22		
Σ			70.15	70.45		
Diff.				+30		
Σ				70.24	+	1
19	17.64454		2	15.63	+	68
20	182.79953			10.75	−	1
21	8.9389			52.72	−	9
22	12.208			2.11	−	2
23	10.750			42.78	+	4
24	21.149			26.40	−	6
25	29.255			42.92	+	2
26	208.2			2.11		
27	19.9			0.53		
28	17.3			0.05		
f+π	24.09			6.67	−	1
Sum			6	32.91	+	68
f+ω	116.07287	+4	24	0.68	−	16.84
p. p.			−	10.33	−	5
Sin.		+4	30	23.26		
Red.				16.78		
		°	′	″		
Lat.		+4	30	40.04		
				.07		

(a) f′+ω′	.11877	log.	0.0747
(b) Δβ₀	−14.18	log.	−1.1517
(c) Δ(f+ω)		log.	9.8625
(a)×(b)			−1.2264
(b)×(c)			−1.0142
	″		
Mot. in 0^d.01	−16.21		
	15		

Geocentric Positions of the Moon.

35. The following table contains the geocentric positions of the moon, computed from Hansen's tables for the dates of the occultations between 1753 and 1858. The last column contains the reduction of Hansen's longitude to the provisional theory. Its value is generally omitted in the case of rejected occultations.

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in 0d.01.	Geocentric Latitude of Moon.	Motion in 0d.01.	Parallax.	Δv.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1753, Apr. 19	15 57 58.1	.6652558	239 40 49.0	7 44.29	+2 7 42.1	+39.23	56 28.7	−0.5
Aug. 5	9 34 35.3	.3990197	221 52 34.2	7 51.65	+1 1 0.4	+40.79	57 9.6	+1.0
Oct. 5	8 10 4.5	.3403299	300 40 22.5	7 9.32	+5 15 29.6	− 2.55	54 18.6	+2.5
5	9 30 22.6	.3960950	301 20 16.6	7 9.14	+5 15 14.3	− 2.96	54 17.8	+2.5
1754, Apr. 2	11 55 11.5	.4976610	132 46 46.6	8 39.85	−4 47 45.8	+20.32	59 44.9	+1.2
Nov. 21	8 0 24.5	.3336170	330 53 39.4	7 14.63	+3 3 4.6	−31.43	54 49.6	+1.8
1755, July 5	16 26 42.0	.6852084	65 39 10.1	7 18.34	−4 48 51.0	−11.47	54 44.7	...
18	8 54 20.9	.3710753	236 11 34.3	8 35.83	+4 35 41.4	+19.80	59 28.7	+0.2
1756, Dec. 12	16 9 53.9	.6735406	152 28 23.8	7 20.39	+0 42 22.7	+38.89	55 13.6	...
12	17 30 45.6	.7296945	153 9 38.5	7 20.86	+0 46 1.0	+38.89	55 15.6	...
1757, Feb. 25	6 38 47.0	.2769329	66 22 51.2	7 15.73	−5 7 32.0	+ 9.58	54 45.5	+1.3
25	7 48 55.1	.3256378	66 58 12.6	7 15.35	−5 6 44.2	+ 9.97	54 44.2	+1.3
Apr. 3	10 21 45.9	.4317814	186 8 14.3	7 56.39	+3 36 4.3	+30.05	57 4.0	−1.3
3	11 18 48.5	.4713948	186 39 42.3	7 56.84	+3 38 2.9	+29.80	57 5.5	−1.3
July 30	11 8 21.3	.4641356	307 31 45.5	9 7.06	+0 32 56.8	−50.40	61 21.6	−1.2
1758, Feb. 17	10 31 33.6	.4385835	93 29 54.7	7 14.68	−2 41 34.6	+34.30	54 45.2	+0.5
1761, Dec. 10	9 38 37.0	.4018171	64 35 27.0	8 46.18	+1 14 32.4	+46.67	60 8.9	−0.6
1764, Feb. 20	13 36 51.6	.5672638	199 43 22.0	8 44.32	−1 18 1.6	−46 31	60 7.7	−2.4
20	14 44 44.5	.6144038	200 24 33.4	8 44.12	−1 21 39.6	−46.16	60 7.1	−2.4
1765, Feb. 4	8 55 57.6	.3721944	123 32 46.5	7 35.90	+3 34 1.2	−30.02	55 49.3	−0.1
4	10 15 11.5	.4272164	124 14 35.9	7 36.33	+3 31 14.7	−30.40	55 51.1	−0.1
Sept. 25	5 54 47.9	.2463877	319 49 38.7	8 22.10	−1 34 38.5	+43.82	58 47.4	+0.8
Oct. 2	12 55 56.9	.5388530	55 55 37.5	7 21.78	+5 5 31.7	+ 7.59	54 58.9	−3.8
2	13 26 1.0	.5597338	56 10 59.8	7 21.58	+5 5 47.4	+ 7.39	54 58.3	−3.8
1766, Sept. 22	10 23 11.0	.4327662	55 37 12.5	7 52.44	+5 7 36.7	− 5.38	56 55.6	−4.2
22	10 39 45.3	.4442743	55 46 16.2	7 52.34	+5 7 30.4	− 5.54	56 55.0	−4.2
1767, Sept. 12	15 17 3.0	.6368403	56 28 43.5	8 19.05	+4 34 29.1	−20.07	58 35.6	−5.4
12	16 29 15.1	.6869804	57 10 23.9	8 18.19	+4 32 46.8	−20.55	58 32.7	−5.4
1768, Jan. 27	11 40 17.3	.4863114	56 54 33.1	8 12.90	+4 17 58.1	−26.12	58 13.3	−1.4
27	12 41 53.1	.5290869	57 29 40.8	8 12.50	+4 16 5.3	−26.47	58 12.0	−1.4
1769, Sept. 15	8 1 42.6	.3345209	351 49 52.2	8 17.79	+5 0 10.1	− 2.08	58 13.6	0.0
20	10 21 51.2	.4318426	64 13 58.8	8 32.89	+1 14 12.0	−43.92	59 30.7	−4.0
20	11 16 54.6	.4700764	64 46 39.7	8 32.82	+1 11 24.0	−44.01	59 30.4	−4.0
25	17 24 13.7	.7251586	138 4 50.5	8 9.56	−4 21 36.2	−23.06	57 54.5	−5.4
Nov. 18	15 4 49.5	.6283508	130 7 19.2	8 22.96	−4 20 7.9	−26.31	57 51.4	−5.5
1770, Apr. 7	11 30 50.7	.4797535	170 47 52.0	8 10.32	−4 58 4.1	+10.52	57 50.0	−2.0
28	9 48 41.6	.4084148	81 57 33.6	8 43.34	−1 27 23.1	−46.06	60 2.5	0.0
July 19	14 37 14.5	.6091956	81 16 35.9	8 53.48	−1 29 0.9	−45.74	60 37.8	−2.0
1771, July 4	12 24 8.6	.5167662	10 28 56.7	7 17.53	+2 55 58.3	−31.93	54 59.9	+0.4
4	13 21 41.2	.5567268	10 58 5.7	7 17.78	+2 53 50.1	−32.14	55 1.2	+0.4
Sept. 18	11 56 20.4	.4974583	301 17 40.2	7 10.89	+5 6 0.7	+ 5.17	54 20.8	−0.2
Dec. 24	9 53 28.7	.4121377	132 29 41.3	8 40.67	−5 3 25.7	+ 4.81	59 39.0	−3.5
1772, May 15	11 52 23.0	.4947106	221 28 35.5	8 46.77	+1 9 37.6	+47.06	60 10.3	−2.4
15	13 4 29.6	.5447869	222 12 33.0	8 46.52	+1 13 32.9	+46.88	60 9.4	−2.4
Aug. 17	11 55 11.4	.4966596	16 44 40.0	7 4.12	+0 23 45.9	−37.92	54 6.3	−0.9
Sept. 7	13 6 25.5	.5461284	301 20 38.1	7 33.92	+5 5 52.5	− 7.77	55 43.2	−0.8
1773, Feb. 6	6 51 36.8	.2858425	129 28 42.0	8 18.03	−4 31 35.8	+20.38	58 17.7	−0.6
Sept. 7	20 45 29.2	.8649212	67 0 36.5	7 7.63	−4 47 45.5	−16.30	54 15.7	−2.1
Nov. 1	8 57 15.6	.3730972	65 59 35.3	7 6.49	−4 40 44.3	−16.13	53 57.7	−1.0
1774, Nov. 18	16 19 55.9	.6805081	67 28 17.8	7 10.90	−5 0 0.2	− 1.48	54 43.0	−0.4
1775, Aug. 1	8 54 17.5	.3710358	187 29 52.5	7 19.94	+3 35 29.4	+29.71	55 2.3	−1.3
Dec. 12	9 59 36.4	.4163934	146 10 23.5	7 4.35	+0 48 46.3	+37.61	54 11.4	−2.7
1776, Jan. 29	12 18 58.2	.5131735	67 2 58.1	7 40.85	−4 55 55.9	+15.45	56 15.0	−0.3
Mar. 30	13 58 13.2	.5820971	146 47 16.8	7 3.85	+1 7 0.3	+36.99	54 3.0	−0.8
Apr. 6	14 4 32.1	.5864825	231 37 49.1	7 35.58	+4 59 58.5	− 5.80	55 45.9	−4.2
1777, Oct. 21	8 0 0.0	.3333333	99 22 58.9	8 18.36	−0 12 45.0	+44.07	58 44.5	−2.4
Nov. 15	18 15 39.7	.7608762	70 34 9.3	9 3.69	−2 30 0.4	+42.72	61 7.2	−0.7
16	11 2 1.0	.4597339	81 2 55.0	8 55.50	−1 38 16.6	+45.73	60 43.2	−1.3
16	12 8 26.6	.5058635	81 44 4.1	8 54.96	−1 34 45.4	+45.88	60 41.2	−1.3

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in $0^d.01$.	Geocentric Latitude of Moon.	Motion in $0^d.01$.	Parallax.	Δv.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1778, Feb. 7	11 24 34.2	.4753958	92 23 40.2	8 28.00	−0 31 28.1	+45.75	59 10.3	+2.6
June 24	3 20 0.0	.1388889	92 52 54.7	9 1.46	+0 18 3.9	+50.07	61 2.2	+0.6
24	5 44 0.0	.2388889	94 23 7.1	9 0.94	+0 26 24.0	+49.92	61 0.6	+0.6
Dec. 31	6 3 11.8	.2522200	72 59 50.5	9 0.74	−0 41 29.9	+49.43	61 2.3	+1.5
1779, Feb. 27	12 32 5.9	.5222906	124 26 42.8	8 46.30	+3 42 46.6	+30.97	60 3.9	+2.5
27	14 32 46.6	.6060950	125 40 14.0	8 46.34	+3 47 3.7	+30.24	60 3.7	+2.5
Oct. 30	10 3 10.4	.4188705	110 5 37.1	8 30.12	+3 52 40.4	+31.34	59 15.1	−1.5
Dec. 22	7 18 42.8	.3046621	83 42 22.3	8 50.36	+1 55 33.0	+44.93	60 21.2	−0.4
1781, Mar. 13	15 0 0.0	.6250000	227 34 53.6	8 34.82	−1 7 3.2	−45.54	59 38.5	−2.0
Oct. 16	20 0 0.0	.8333333	203 46 38.3	9 8.19	+0 9 25.5	−50.79	61 25.2	−0.4
1783, Feb. 9	6 0 0.0	.2500000	56 38 18.1	7 8.73	+4 24 9.1	+20.35	54 22.2	−0.8
9	6 36 0.0	.2750000	56 56 10.0	7 8.69	+4 24 59.9	+20.20	54 21.8	−0.8
May 16	11 17 28.2	.4704653	239 17 39.2	9 1.93	−4 31 30.4	−21.42	60 51.5	−0.8
Oct. 7	14 24 56.3	.6006517	344 44 58.0	8 19.14	−0 21 6.8	+45.61	58 35.3	−0.9
Dec. 6	16 14 11.3	.6765198	56 53 25.4	7 26.18	+4 45 59.1	+11.42	55 8.4	−1.8
6	16 50 16.8	.7015835	57 12 3.6	7 25.98	+4 46 27.7	+11.22	55 7.8	−1.8
30	8 6 9.4	.3376089	11 28 3.2	7 55.09	+2 31 59.1	+36.57	57 19.7	−1.3
30	9 11 12.5	.3827837	12 3 48.8	7 54.51	+2 34 43.9	+36.30	57 17.5	−1.3
1784, July 2	12 29 59.3	.5208254	281 45 51.8	8 59.32	−3 54 30.9	+31.07	60 45.6	−2.1
1785, Apr. 11	8 40 0.0	.3611111	57 1 35.8	8 30.29	+5 1 2.1	− 6.32	59 4.6	−2.6
11	9 16 0.0	.3861111	57 22 51.1	8 29.90	+5 0 45.9	− 6.55	59 3.5	−2.6
June 22	11 56 59 2	.4979076	276 54 12.1	8 15.25	−3 1 8.6	+36.18	58 13.9	−1.7
Aug. 16	8 2 16.6	.3349145	277 22 50.9	8 12.34	−3 0 40.4	+37.23	58 13.7	+0.1
1786, Mar. 5	6 40 0.0	.2777777	56 36 57.8	8 32.14	+4 41 11.2	−19.08	59 20.0	−1.0
5	7 16 0.0	.3027778	56 58 18.1	8 31.85	+4 40 22.8	−19.35	59 19.0	−1.0
Nov. 12	17 20 2.0	.7222454	145 44 57.2	7 42.32	−3 16 13.9	−31.67	56 31.5	−4.9
12	18 36 7.3	.7750845	146 25 38.5	7 41.66	−3 19 1.1	−31.35	56 29.0	−4.9
Dec. 9	10 50 13.3	.4515428	137 44 1.3	8 6.09	−2 52 27.1	−37.16	57 55.9	−4.1
9	10 26 39.3	.4768437	138 4 30.8	8 5.70	−2 54 1.0	−37.02	57 54.4	−4.1
1787, Nov. 26	11 10 40.0	.4657407	89 49 32.8	9 1.06	−0 20 10.5	−49.76	61 2.5	−4.4
26	12 19 33.9	.5135867	90 32 40.9	9 0.85	−0 24 8.4	−49.70	61 1.8	−4.4
26	15 26 26.5	.6433621	92 29 35.2	9 0.13	−0 34 52.0	−49.47	60 59.8	−4.4
26	15 41 40.1	.6359361	92 39 6.4	9 0.09	−0 35 44.3	−49.47	60 59.7	−4.4
1788, May 11	9 25 14.7	.3925310	130 44 1.2	8 31.43	−4 13 17.8	−27.70	59 19.2	−1.5
Oct. 18	10 33 37.6	.4400183	73 7 34.0	8 13.64	−0 25 25.5	−44.54	58 19.3	−3.3
18	11 30 12.0	.4793053	73 39 53.5	8 13.83	−0 28 20.4	−44.50	58 20.1	−3.3
Nov. 15	7 23 13.7	.3077975	81 8 7.2	8 29.80	−1 13 7.9	−45.75	59 11.6	−3.4
15	7 50 46.5	.3269272	81 24 22.3	8 29.85	−1 14 35.5	−45.73	59 12.0	−3.4
1789, Nov. 9	12 7 20.8	.5051020	132 37 23.6	8 20.75	−5 15 22.1	− 5.37	58 37.6	−3.1
1790, Mar. 5	17 28 52.6	.7283868	234 34 51.2	8 24.27	+1 8 47.3	+43.99	59 4.1	−4.4
Aug. 17	8 11 52.3	.3415778	241 40 43.9	8 19.17	+2 22 52.1	+39.08	58 43.3	−0.6
Oct. 15	5 34 56.7	.2326009	300 59 37.4	7 47.19	+5 17 42.2	+ 0.15	56 40.0	−0.5
Nov. 17	12 51 54.8	.5360512	15 4 4.6	7 4.76	+1 26 57.6	−37.56	54 4.9	+1.4
1791, Mar. 16	12 15 11.3	.5105477	133 13 22.5	8 4.63	−4 53 16.4	+15.86	57 36.2	+0.5
Apr. 3	0 0 0.0	.0000000	13 19 5.7	7 15.28	+0 47 11.0	−39.83	54 38.0	...
7	6 54 25.4	.2877943	64 16 51.6	7 5.23	−3 34 44.7	−28.94	54 3.6	+2.0
7	7 34 8.9	.3153811	64 36 24.8	7 5.28	−3 36 4.5	−28.79	54 3.8	+2.0
June 12	9 43 45.6	.4053892	213 42 22.8	8 47.04	+1 12 32.1	+45.56	60 18.2	−0.7
Dec. 15	16 24 3.3	.6833718	146 1 31.2	7 26.52	−3 27 37.6	+28.50	55 27.9	−1.9
1792, Mar. 27	8 42 22.5	.3630151	67 22 17.5	7 13.35	−4 44 51.6	−17.46	54 33.2	+1.8
Apr. 9	11 23 26.3	.4746100	236 6 46.1	8 40.30	+4 10 59.2	+28.76	59 41.5	−5.2
9	12 28 54.3	.5200730	236 46 11.9	8 40.44	+4 13 9.4	+28.36	59 41.9	−5.2
1793, Apr. 19	11 28 30.1	.4781263	138 54 55.7	7 5.79	−2 12 17.0	+34.78	54 15.7	+0.8
1794, Mar. 5	7 1 21.2	.2926067	39 27 24.4	8 35.74	−5 1 59.0	−13.90	59 29.4	−0.3
7	6 46 30.0	.2822919	67 4 18.9	8 3.42	−5 10 57.0	+ 7.98	57 39.2	+0.5
Aug. 4	9 33 22.0	.3981715	232 13 2.9	7 24.02	+5 16 21.3	− 3.14	55 14.7	−1.2
Nov. 8	7 11 43.1	.2998046	66 9 42.7	8 50.77	−4 35 32.0	+18.43	60 14.3	−1.1
8	8 3 44.9	.3359366	66 41 39.4	8 50.19	−4 34 24.7	+18.76	60 12.8	−1.1
Dec. 18	18 29 56.9	.7707977	231 55 13.4	7 19.11	+5 1 19.6	− 3.55	54 45.8	−2.4
1795, May 4	12 41 4.1	.5285199	234 28 31.2	7 9.07	+4 38 32.5	−13.93	54 4.4	−2.5
July 25	9 9 48.9	.3818162	234 19 42.0	7 8.96	+4 47 15.3	−16.58	54 18.4	−1.6
Aug. 6	12 30 11.9	.5209710	34 13 44.9	8 32.20	−5 14 32.5	+ 4.13	59 16.1	−4.2
28	11 50 27.2	.4933703	319 4 42.6	8 8.78	−1 47 25.9	−41.52	57 55.5	−2.8
Sept. 28	7 24 10.3	.3084525	7 25 0.6	8 53.00	−4 45 3.8	−15.42	60 18.8	−3.0
Oct. 6	12 39 40.2	.5275485	125 19 29.4	7 54.82	+0 48 36.2	+41.35	57 18.1	−2.4
Nov. 24	7 15 41.2	.3025601	38 37 19.6	9 6.18	−4 53 17.5	+14.57	61 6.8	−0.4
1796, Mar. 14	7 10 47.3	.2991585	64 15 29.6	8 32.98	−3 28 14.4	+33.02	59 25.8	+1.4
14	7 49 15.2	.3258703	64 38 19.8	8 32.87	−3 26 45.8	+33.22	59 25.6	+1.4
Aug. 20	11 31 22.0	.4801157	356 21 31.7	7 52.95	−4 58 48.9	− 9.70	56 47.8	−3.4
1797, Mar. 17	12 52 22.4	.5363703	241 23 44.5	7 28.04	+2 10 39.0	−35.59	55 38.0	−2.0

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in 0d.01.	Geocentric Latitude of Moon.	Motion in 0.d01.	Parallax.	Δv.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1797, Dec. 25	4 31 20.6	.1884328	356 3 45.4	7 12.45	−5 7 8.9	+ 8.65	54 32.8	−0.3
1798, Aug. 8	13 36 46.1	.5672002	96 46 9.8	8 24.92	+2 56 5.3	+36.01	58 56.1	+0.7
Oct. 5	15 46 15.4	.6571227	144 3 26.7	8 48.28	+5 9 6.0	+ 1.53	60 9.6	+0.4
1799, Apr. 10	10 43 14.4	.4466944	82 59 31.3	7 26.29	+3 10 30.7	+32.59	55 28.6	+2.4
21	10 53 34.9	.4538761	239 25 14.6	8 50.42	−1 15 6.8	−47.61	60 27.0	−0.9
1800, May 5	9 28 57.4	.3951088	181 36 47.8	8 33.61	+2 18 16.1	−42.53	59 30.3	+3.6
5	10 24 57.3	.4339965	182 10 6.6	8 34.30	+2 15 30.1	−42.80	59 32.4	+3.6
July 4	10 24 22.7	.4335960	258 49 9.9	9 1.10	−4 5 53.6	−27.33	60 52.2	+1.0
Sept. 30	9 42 48.6	.4047291	343 31 19.5	7 56.04	−3 1 22.6	+35.88	57 6.7	−0.7
Nov. 26	14 13 19.1	.5925821	17 44 59.9	7 23.55	+0 0 32.2	+39.95	55 18.8	−1.8
1801, Jan. 5	18 29 59.8	.7708307	174 9 34.3	7 39.58	+1 39 1.5	−38.16	56 22.2	+0.8
5	19 25 33.6	.8094164	174 39 8.9	7 39.98	+1 36 33.9	−38.31	56 23.8	+0.8
Mar. 30	13 57 7.0	.5813307	200 41 5.8	8 13.94	−1 3 53.0	−44.70	58 13.5	+0.8
30	15 5 43.9	.6289800	201 21 10.1	8 14.34	−1 7 25.7	−44.60	58 14.9	+0.8
Apr. 24	7 28 49.7	.3116861	165 14 43.0	7 42.46	+2 6 34.8	−38.74	56 28.0	+3.8
May 21	9 41 25.0	.4037616	161 44 5.4	7 29.82	+2 14 46.6	−36.16	55 47.2	+4.0
24	8 51 12.0	.3688889	200 28 54.7	8 13.85	−1 7 57.5	−42.96	58 21.7	+4.0
24	10 1 8.3	.4174572	201 8 55.3	8 14.66	−1 11 26.2	−42.96	58 24.3	+4.0
Oct. 23	12 0 0.0	.5000000	56 51 56.8	7 41.93	+4 22 24.3	+22.56	56 11.7	−1.4
23	13 12 0.0	.5500000	57 30 25.3	7 41.38	+4 24 16.3	+22.14	56 9.7	−1.4
23	14 24 0.0	.6000000	58 8 51.2	7 40.85	+4 26 6.3	+21.69	56 7.8	−1.4
1802, Mar. 14	12 6 23.8	.5044422	124 48 35.2	7 5.22	+3 48 7.8	−27.26	54 3.6	+0.7
July 23	14 30 0.0	.6041667	57 8 39.3	7 47.10	+4 58 43.1	+11.06	56 37.0	−3.3
23	15 42 0.0	.6541667	57 47 34.2	7 46.68	+4 59 37.5	+10.63	56 35.1	−3.3
Nov. 3	4 52 56.0	.2034260	319 14 57.1	8 27.06	−1 46 51.9	+42.33	59 12.1	+3.5
3	7 52 13.7	.3279364	321 0 15.9	8 27.92	−1 38 1.3	+42.85	59 15.2	+3.5
1803, Mar. 3	6 11 40.9	.2581123	110 15 17.4	7 24.89	+3 33 35.1	−30.39	55 19.5	+0.4
3	7 26 27.6	.3100417	110 53 46.9	7 24.49	+3 30 56.4	−30.64	55 17.8	+0.4
1804, July 17	9 28 28.4	.3947731	240 5 11.2	7 9.41	−4 46 13.0	+16.64	54 16.8	+1.5
Dec. 14	14 0 0.0	.5833333	57 21 53.9	9 5.85	+4 26 25.6	−25.69	61 8.1	−0.2
14	15 12 0.0	.6333333	58 7 13.9	9 6.14	+4 24 15.5	−26.21	61 9.2	−0.2
1805, Aug. 6	7 29 40.1	.3122696	273 8 20.3	7 4.93	−1 12 9.5	+37.93	54 6.1	+0.4
Sept. 7	8 2 41.5	.3352024	330 11 27.8	7 33.10	+3 36 55.2	+28.14	55 39.0	+0.5
7	9 14 45.7	.3852510	330 49 16.5	7 33.55	+3 39 15.5	+27.82	55 40.6	+0.5
1806, June 16	4 22 0.0	.1819444	84 45 7.9	8 48.44	+0 19 16.8	−48.85	60 16.6	...
16	5 34 0.0	.2319444	85 29 10.8	8 48.75	+0 15 12.6	−48.92	60 17.9	...
1807, Dec. 14	12 36 36.2	.5254188	82 3 21.1	7 46.50	−1 55 33.9	−39.81	56 31.8	+0.9
14	13 25 37.2	.5594582	82 29 49.5	7 46.83	−1 57 49.2	−39.67	56 32.9	+0.9
1808, Apr. 5	17 25 30.9	.7260519	130 52 13.8	8 16.37	−5 6 25.7	− 8.57	58 23.4	+2.9
May 3	16 0 49.9	.6672440	139 24 18.8	8 10.81	−5 17 25.7	− 1.52	58 3.8	+2.7
Oct. 31	8 35 12.3	.3577810	11 19 27.4	7 10.30	+2 44 9.0	−34.08	54 19.5	+0.2
1809, Feb. 27	8 17 2.0	.3451618	129 45 16.7	7 52.59	−5 4 19.8	+ 3.64	56 47.5	+2.1
Apr. 3	14 37 9.3	.6091354	241 26 5.2	8 46.97	+2 29 53.0	+42.70	60 14.7	−1.3
3	15 48 5.2	.6583935	242 9 20.3	8 46.77	+2 33 22.7	+42.35	60 13.8	−1.3
29	16 32 56.5	.6895428	221 40 35.3	9 1.98	+0 47 8.8	+49.65	61 3.6	+0.3
29	17 58 22.2	.7488680	222 34 11.4	9 2.23	+0 52 3.1	+49.51	61 4 4	+0.3
May 28	11 50 17.8	.4932615	242 6 47.9	9 8.71	+2 33 5.0	+43.41	61 23.5	+0.2
June 23	13 13 50.7	.5512812	221 43 39.3	8 44.07	+0 55 18.7	+45.95	60 9.1	+2.2
28	21 13 39.6	.8844860	301 42 17.6	8 49.63	+5 3 18.4	− 0.80	60 9.7	−1.0
28	22 27 11.2	.9355461	302 27 20.4	8 49.00	+5 3 12.7	− 1.36	60 7.5	−1.0
Sept. 28	9 37 46.0	.4012267	64 16 39.4	7 9.84	−3 24 5.2	−30.17	54 25.4	+1.0
Nov. 12	10 29 19.2	.4370276	301 18 52.7	8 32.35	+5 11 23.3	− 6.11	59 18.5	+1.0
12	11 54 47.6	.4963841	302 9 31.8	8 31.60	+5 10 45.2	− 6.75	59 16.0	+1.0
Dec. 15	10 10 13.7	.4237696	17 37 37.5	7 28.68	+0 24 36.9	−39.90	55 43.4	+1.4
1810, Jan. 15	13 23 39.3	.5580938	64 38 29.5	7 7.66	−3 35 19.5	−26.15	54 13.6	+1.9
15	13 53 51.4	.5790672	64 53 26.4	7 7.62	−3 36 14.3	−26.01	54 13.3	+1.9
Feb. 18	14 41 52.8	.6124167	145 48 48.3	7 15.72	−3 54 47.7	+25.66	55 9.1	+1.6
May 10	9 12 28.3	.3836609	130 34 36.2	7 9.68	−4 39 10.7	+17.21	54 23.6	+2.7
June 15	11 57 32.4	.4982917	245 11 11.9	8 52.44	+4 2 7.3	+27.86	60 23.3	+1.1
July 25	13 41 32.4	.5705139	63 32 43.7	7 17.94	−4 10 7.0	−21.82	54 52.6	−0.4
25	14 27 13.4	.6022384	63 55 52.7	7 17.73	−4 11 16.3	−21.64	54 51.6	−0.4
Sept. 18	9 54 7.8	.4125902	66 25 9.8	7 30.00	−4 36 51.7	−20.10	55 39.6	−1.0
18	10 47 7.4	.4493911	66 52 45.5	7 29.62	−4 38 5.4	−19.79	55 38.0	−1.0
1811, Jan. 19	15 47 52.1	.6582418	236 40 42.9	8 11.00	+4 19 52.8	+22.72	58 7.7	+0.1
Mar. 1	6 40 0.0	.2777778	66 41 36.9	7 38.55	−4 58 8.4	−14.09	56 11.3	+2.3
1	7 52 0.0	.3277778	67 19 48.4	7 37.81	−4 59 18.1	−13.69	56 8.9	+2.3
1	9 4 0.0	.3777778	67 57 56.7	7 37.30	−5 0 25.6	−13.24	56 6.5	+2.3
7	11 1 44.7	.4595451	141 22 38.5	7 5.48	−3 1 43.1	+32.16	54 0.0	+1.7
27	7 33 14.8	.3147546	49 0 32.4	8 11.58	−4 12 45.5	−27.31	58 5.5	...
July 15	22 37 56.3	.9430127	66 17 25.2	7 46.27	−4 58 23.8	− 9.01	56 29.1	−0.3

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in 0d.01.	Geocentric Latitude of Moon.	Motion in 0d.01.	Parallax.	Δπ.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1811, July 26	15 0 55.7	.6256446	195 56 53.2	7 12.70	+2 25 21.3	+34.62	54 41.7	+1.2
Aug. 26	9 4 44.2	.3782893	238 51 48.0	7 41.77	+5 0 56.6	+13.35	56 22.0	+1.4
Sept. 2	9 24 1.9	.3916886	338 45 12.1	9 8.21	+0 47 8.0	−50.26	61 25.3	−0.7
2	11 29 35.4	.4788819	340 4 52.1	9 8.18	+0 39 49.2	−50.35	61 25.3	−0.7
17	7 8 0.0	.2972222	174 4 49.8	7 5.41	+0 37 32.0	+39.16	54 1.2	...
Oct 8	20 13 10.0	.8424768	105 49 5.0	7 27.12	−4 35 54.7	+19.62	55 30.7	−1.2
8	21 18 33.0	.8878819	106 22 54.4	7 26.60	−4 34 24.5	+19.94	55 28.8	−1.2
23	6 30 20.3	.2710683	283 23 25.8	8 5.23	+4 36 12.3	−19.79	57 45.5	+2.4
23	13 19 50.3	.5554433	287 14 2.9	8 7.96	+4 26 9.7	−22.46	57 56.1	+2.4
27	5 7 46.5	.2137362	338 35 57.0	8 42.27	+0 41 48.8	−46.71	60 3.1	+2.6
1812, Jan. 23	7 4 36.5	.2948669	67 0 2.8	8 1.46	−5 11 20.4	− 1.24	57 24.9	+2.3
23	7 34 32.4	.3156528	67 16 43.6	8 1.37	−5 11 22.9	− 1.08	57 24.3	+2.3
Apr 14	5 40 48.7	.2366748	67 31 18.7	8 34.56	−5 8 27.2	+ 0.44	59 21.6	+2.2
14	6 22 27.0	.2655903	67 56 6.0	8 34.08	−5 8 25.5	+ 0.73	59 20.0	+2.2
May 24	20 25 39.7	.8511540	232 51 30.8	7 24.58	+4 54 57.1	+ 7.18	55 1.6	−0.9
July 30	15 34 38.5	.6492883	39 26 57.5	8 28.84	−4 56 44.2	−15.66	59 6.8	−0.8
Aug. 28	18 53 6.3	.7868786	66 11 5.3	8 19.89	−5 14 48.6	+ 5.72	58 35.1	−0.5
28	19 50 54.1	.8270152	66 44 31.2	8 19.50	−5 14 24.7	+ 6.10	58 33.6	−0.5
Oct. 19	13 2 36.0	.5434724	21 59 35.1	9 12.02	−4 8 41.9	−28.08	61 28.1	+0.2
19	15 16 20.3	.6363463	23 25 3.3	9 12.24	−4 12 59.1	−27.11	61 28.6	+0.2
21	10 8 47.8	.4227757	50 44 37.8	9 5.44	−5 2 7.6	− 5.22	61 3.1	−0.1
21	11 3 51.1	.4610084	51 19 22.7	9 5.00	−5 2 26.7	− 4.74	61 1.9	−0.1
22	8 21 40.9	.3483904	64 37 53.2	8 54.04	−5 1 11.7	+ 6.30	60 27.4	−0.2
22	9 16 26.0	.3864120	65 11 42.8	8 53.52	−5 9 46.7	+ 6.78	60 25.7	−0.2
22	11 46 30.1	.4906261	66 44 15.5	8 52.01	−4 59 29.5	+ 7.98	60 20.9	−0.2
22	12 39 31.1	.5274433	67 16 52.8	8 51.48	−4 58 59.3	+ 8.44	60 19.2	−0.2
Nov. 24	17 14 33.7	.7184455	146 16 7.3	7 30.08	+0 14 36.4	+39.71	55 52.0	+0.2
24	17 33 34.2	.7316457	146 26 1.3	7 29.89	+0 15 28.8	+39.68	55 51.4	+0.2
Dec. 10	13 3 24.2	.5440300	342 12 20.5	8 11.49	−1 46 47.4	−40.96	58 18.0	+2.9
10	14 5 45.9	.5873367	342 47 50.0	8 11.94	−1 49 44.7	−40.82	58 19.6	+2.9
14	14 7 37.3	.5886262	39 52 29.8	8 51.74	−4 58 24.2	− 9.42	60 19.3	+3.8
16	4 40 0.0	.1944444	63 42 25.6	8 54.62	−4 57 41.7	+10.08	60 24.5	+3.8
16	5 52 0.0	.2444444	64 26 58.7	8 54.49	−4 56 49.7	+10.64	60 24.0	+3.8
16	7 4 0.0	.2944444	65 11 30.9	8 54.40	−4 55 54.7	+11.30	60 23.6	+3.8
16	8 16 0.0	.3444444	65 56 2.5	8 54.20	−4 54 56.8	+11.83	60 23.0	+3.8
16	9 28 0.0	.3944444	66 40 33.2	8 54.06	−4 53 55.9	+12.48	60 22.5	+3.8
16	10 40 0.0	.4444444	67 25 3.2	8 53.84	−4 52 52.0	+13.06	60 21.9	+3.8
16	11 52 0.0	.4944444	68 9 32.2	8 53.72	−4 51 45.1	+13.57	60 21.3	+3.8
1813, Mar. 6	8 50 23.7	.3683299	39 52 26.0	8 45.28	−5 9 10.2	− 7.85	59 58.6	+2.9
8	6 17 14.8	.2619769	67 9 9.6	8 30.57	−4 58 40.3	+14.06	59 13.4	+3.7
Apr. 8	5 41 58.5	.2374827	118 25 20.6	7 56.78	−1 41 59.7	+40.08	57 25.9	+4.2
8	6 54 15.1	.2876748	119 5 12.1	7 56.14	−1 38 38.2	+40.17	57 23.7	+4.2
10	5 19 13.4	.2216829	144 5 24.4	7 35.76	+0 33 11.4	+40.33	56 6.5	...
10	6 33 12.1	.2730576	144 44 25.3	7 35.38	+0 36 38.4	+40.22	56 4.7	...
17	10 24 42.6	.4338264	231 40 55.7	7 7.37	+5 0 12.0	− 3.20	53 58.6	−0.4
17	11 36 4.9	.4833900	232 16 13.8	7 7.36	+4 59 55.3	− 3.52	53 58.7	−0.4
July 11	11 2 53.3	.4603390	270 27 49.9	7 18.33	+3 2 49.4	−30.54	54 46.7	−0.6
12	12 56 53.3	.5395080	283 42 6.9	7 24.92	+2 22 21.8	−36.34	55 12.5	−1.2
Aug. 13	11 52 57.9	.4951145	343 55 48.5	8 9.64	−2 54 21.6	−37.51	57 55.7	−1.4
Sept. 14	12 31 41.5	.5220080	50 57 38.8	8 39.77	−5 3 26.9	+ 9.03	59 40.2	−0.2
Nov. 29	5 50 37.8	.2434930	321 8 14.7	7 28.18	−1 37 18.8	−38.09	55 41.9	+1.3
Dec. 28	7 33 33.9	.3149754	344 10 32.9	7 42.51	−3 34 27.9	−31.03	56 28.0	+2.2
1814, Jan. 1	9 22 53.4	.3908959	39 35 17.5	8 38.47	−5 12 20.0	+ 6.75	59 38.3	+4.8
28	8 43 31.7	.3635614	35 14 19.8	8 19.28	−5 16 40.3	+ 3.24	58 33.1	+4.5
Feb. 1	11 37 58.7	.4847072	94 22 0.0	8 48.50	−2 23 49.9	+43.47	60 18.0	+6.1
Oct. 1	10 29 32.1	.4371771	38 51 14.1	8 16.48	−4 42 26.2	+15.02	58 13.4	−0.1
1	11 30 20.7	.4794062	39 26 11.2	8 16.76	−4 41 21.6	+15.45	58 14.5	−0.1
Nov. 29	19 36 41.2	.8171435	106 35 58.3	8 51.09	+0 17 11.9	+48.32	60 30.3	+1.4
1816, Apr. 12	8 59 53.9	.3749294	211 6 47.7	8 54.53	+3 38 38.9	−33.13	60 31.1	+4.4
Dec. 7	7 34 43.5	.3157812	110 43 58.6	7 55.98	+3 42 8.7	+31.15	57 6.2	+1.1
1817, Dec. 30	14 53 17.1	.6203367	186 40 1.5	8 12.48	+3 17 24.6	−33.77	58 18.0	+2.9
1818, Feb. 13	6 7 52.0	.2554628	60 44 44.1	7 4.55	+1 36 15.9	+35.60	54 13.8	+0.8
13	6 32 29.2	.2725600	60 56 49.9	7 4.55	+1 37 16.8	+35.56	54 13.8	+0.8
Apr. 12	7 51 18.7	.3272998	101 10 27.6	7 11.89	+4 40 19.4	+18.36	54 32.2	+2.6
1819, Sept. 8	15 10 37.8	.6323820	49 31 19.4	7 48.09	+3 14 12.8	+33.61	56 50.0	−2.3
Oct. 9	14 46 30.9	.6156355	94 55 23.6	7 17.10	+5 15 4.8	+ 4.38	54 49.3	−1.4
1820, Feb. 1	10 27 20.3	.4356517	161 7 42.3	7 5.27	+1 54 4.8	−35.37	54 2.4	+0.6
1	11 36 6.9	.4834132	161 41 33.7	7 5.32	+1 51 15.5	−35.51	54 2.8	+0.6
Apr. 23	7 24 47.1	.3088785	161 40 33.0	7 6.76	+1 47 15.0	−36.65	54 15.5	+1.9
Aug. 28	11 56 24.6	.4975069	45 11 26.4	8 20.02	+4 10 16.2	+28.05	58 41.4	−3.0

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in 0ᵈ.01.	Geocentric Latitude of Moon.	Motion in 0ᵈ.01.	Parallax.	Δr.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1820, Aug. 28	12 59 29.3	.5413113	45 47 55.5	8 19.39	+4 12 18.6	+27.62	58 39.1	−3.0
1821, Feb. 6	5 50 0.0	.2430555	11 51 6.2	8 43.06	+2 28 0.5	+42.28	60 3.0	+1.3
6	7 2 0.0	.2930555	12 34 40.8	8 42.70	+2 31 31.3	+41.94	60 1.7	+1.3
6	12 20 10.1	.5140058	15 46 51.7	8 41.00	+2 46 43.4	+40.47	59 55.8	+1.3
12	6 49 13.0	.2841782	94 55 15.9	7 46.54	+4 54 4.8	−15.29	56 31.5	+1.5
May 6	9 18 13.4	.3876551	111 16 50.1	7 54.12	+3 53 56.4	−26.87	57 9.2	+1.3
6	9 32 6.6	.3972986	111 24 27.3	7 55.92	+3 53 30.3	−26.96	57 8.7	+1.3
July 22	11 12 57.2	.4673286	41 23 26.1	8 29.58	+4 45 13.5	+18.48	59 9.7	−2.0
23	12 40 0.0	.5277778	56 22 4.9	8 26.85	+5 7 53.1	+ 6.90	58 55.9	−2.0
23	13 52 0.0	.5777778	57 4 19.0	8 26.70	+5 8 26.6	+ 6.38	58 55.2	−2.0
23	15 4 0.0	.6277778	57 46 32.4	8 26.47	+5 8 57.2	+ 5.79	58 54.4	−2.0
25	15 14 38.8	.6351713	85 45 46.1	8 16.10	+4 51 28.2	−15.82	58 13.6	−1.7
Sept. 10	8 49 20.2	.3675949	332 38 58.7	8 42.32	−0 11 6.2	+48.20	59 56.9	+0.8
Oct. 8	5 33 41.3	.2317280	353 21 54.2	8 55.50	+1 42 52.5	+45.54	60 42.0	+1.9
13	9 10 0.0	.3819444	56 18 19.9	8 58.67	+5 5 18.7	+ 6.10	60 42.7	−1.9
13	10 22 0.0	.4319444	57 3 11.9	8 58.02	+5 5 47.6	+ 5.42	60 40.8	−1.9
15	8 53 8.5	.3702372	85 16 57.1	8 28.82	+4 45 52.9	−16.84	59 8.1	−2.4
15	9 33 22.8	.3981805	85 40 38.6	8 28.39	+4 45 5.3	−17.09	59 6.6	−2.4
Dec. 7	8 0 0.0	.3333333	56 46 57.1	9 3.53	+5 1 2.8	+ 1.27	60 54.8	+1.6
7	9 12 0.0	.3833333	57 32 15.0	9 3.58	+5 1 7.5	+ 0.61	60 54.8	+1.6
1822, Feb. 8	10 0 0.0	.4166667	171 46 16.2	7 33.22	−2 21 44.6	−37.43	55 47.9	+2.2
8	11 12 0.0	.4666667	172 24 0.9	7 32.66	−2 24 51.1	−37.13	55 46.1	+2.2
27	6 5 29.9	.2538182	57 28 1.1	8 33.16	+5 15 49.8	− 1.79	59 19.9	+2.0
27	6 30 28.9	.2711678	57 42 51.3	8 33.04	+5 15 46.5	− 1.97	59 19.6	+2.0
Apr. 30	12 42 58.9	.5298484	162 28 12.5	7 28.92	−1 45 17.3	−37.04	55 39.8	+3.4
May 1	7 31 57.2	.3138565	172 10 58.3	7 23.20	−2 31 36.7	−33.64	55 14.5	+3.6
1	7 53 55.6	.3291157	172 22 14.6	7 23.16	−2 32 28.2	−33.53	55 14.1	+3.6
Aug. 10	9 0 0.0	.3750000	56 45 15.9	8 33.47	+5 11 25.9	− 8.60	59 21.5	−1.8
10	10 12 0.0	.4250000	57 28 4.4	8 33.70	+5 10 41.0	− 9.27	59 22.2	−1.8
Sept. 6	14 6 6.0	.5875693	56 35 35.1	8 33.60	+5 7 34.0	− 8.64	59 20.9	−2.1
Oct. 31	5 30 0.0	.2291667	56 34 21.0	9 3.85	+4 50 21.3	−11.98	60 56.9	−1.7
31	6 42 0.0	.2791667	57 19 40.1	9 3.71	+4 49 19.8	−12.51	60 56.9	−1.7
31	7 54 0.0	.3291667	58 4 58.8	9 3.62	+4 48 15.1	−13.17	60 56.8	−1.7
Nov. 30	7 39 38.2	.3191921	96 39 38.6	9 1.42	+2 41 39.5	−40.66	61 0.8	−1.5
Dec. 25	3 20 0.0	.1388889	56 17 45.7	8 58.13	+4 54 49.2	−15.73	60 42.0	+2.2
25	4 32 0.0	.1888889	57 2 37.6	8 58.63	+4 53 28.5	−16.48	60 43.9	+2.2
25	5 44 0.0	.2388889	57 47 32.3	8 59.20	+4 52 4.7	−16.97	60 45.7	+2.2
1823, Jan. 23	6 59 31.2	.2913327	82 19 19.7	. .....	+3 42 53.2	.....	60 33.2	...
24	6 0 19.6	.2502268	96 36 12.0	8 57.72	+2 40 10.0	−42.91	60 47.3	+2.3
24	6 8 47.6	.2561060	96 41 27.8	. .....	+2 39 44.8	.....	60 47.3	+2.3
24	7 34 45.5	.3158044	97 34 59.0	8 57.84	+2 35 26.9	−43.35	60 47.7	+2.3
Apr. 13	8 59 42.0	.3747910	57 39 0.9	. .....	+4 34 7.4	.....	59 40.7	...
13	9 3 1.4	.3771116	57 41 1.7	. .....	+4 34 3.0	.....	59 40.8	...
May 18	8 55 21.7	.3717789	166 39 33.9	7 59.45	−3 41 57.5	−29.06	57 27.9	+3.2
June 17	10 56 3.6	.4555972	203 43 6.8	7 35.62	−5 11 23.8	− 3.21	55 53.9	+3.7
20	9 49 29.0	.4093640	240 10 16.5	. .....	−4 24 56.3	.....	54 31.8	...
Sept. 23	7 7 45.0	.2970486	41 53 17.9	8 8.74	+4 51 9.1	−12.14	57 47.9	−1.1
1824, Jan. 7	6 6 43.8	.2546736	356 8 52.4	7 19.98	+4 54 5.4	+15.48	55 0.5	+3.8
Mar. 4	6 33 27.8	.2732379	27 38 48.2	. .....	+4 59 34.3	.....	55 57.3	...
5	8 23 25.1	.3495962	41 27 30.9	. .....	+4 37 9.5	.....	56 33.0	...
12	7 28 51.3	.3117049	138 23 21.0	8 55.34	−2 41 10.4	−40.18	60 39.5	+2.4
12	12 55 22.8	.5384584	141 45 53.3	8 56.40	−2 56 4.9	−38.65	60 41.9	+2.4
Apr. 5	7 43 49.3	.3220985	91 39 16.7	8 16.04	+1 2 58.7	−42.75	58 33.2	+2.5
5	9 6 40.2	.3796314	92 26 51.7	. .....	+0 58 32.4	.....	58 34.7	+2.5
Sept. 4	8 53 44.1	.3706495	302 52 24.1	7 6.82	+2 10 16.2	+34.18	54 11.0	+3.4
30	6 41 19.0	.2786927	286 33 14.6	. .....	+1 1 43.9	.....	54 56.3	...
30	9 21 3.2	.3896197	287 53 41.6	. .....	+1 8 39.8	.....	54 52.9	...
Nov. 29	7 32 54.1	.3145152	350 39 22.0	7 9.10	+5 10 0.3	+ 6.71	54 19.0	+2.7
Dec. 7	5 59 56.9	.2499643	92 28 20.5	8 19.90	−0 12 7.4	−46.05	58 35.5	−0.5
31	12 4 46.3	.5033138	49 58 3.5	7 44.43	+3 25 28.6	−32.56	56 32.2	+1.9
1825, Jan. 3	8 16 59.4	.3451319	88 11 23.2	8 23.93	+0 11 53.3	−46.46	58 51.1	+0.7
Feb. 11	16 32 50.3	.6894710	258 40 8.5	7 40.37	−0 55 10.2	+40.60	56 25.6	−0.3
27	9 43 45.2	.4053844	91 7 15.0	. .....	−0 19 34.6	.....	57 59.3	+3.5
27	9 51 6.5	.4104918	91 11 23.3	8 5.73	−0 19 56.5	−42.91	57 59.6	+3.5
Mar. 24	9 2 17.0	.3765856	61 23 2.9	7 26.69	+1 58 15.9	−36.14	55 31.0	+3.6
24	9 19 39.2	.3886481	61 32 1.5	7 26.76	+1 57 32.2	−36.20	55 31.4	+3.6
28	7 17 5.3	.3035336	112 26 13.9	8 15.20	−2 22 50.7	−38.46	58 30.4	+3.8
Apr. 1	7 26 57.4	.3103865	170 55 58.6	9 8.67	−5 1 9.4	− 2.50	61 13.3	+3.0
June 27	11 10 34.6	.4656782	244 57 50.1	8 17.05	−1 27 38.6	+43.96	58 27.4	+3.3
27	11 13 0.4	.4673660	244 59 14.1	. .....	−1 27 31.3	.....	58 27.3	+3.3

Date.		Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in 0d.01.	Geocentric Latitude of Moon.	Motion in 0d.01.	Parallax.	Δr.
		h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1825, July	4	13 5 28.3	.5454664	336 44 7.5	7 16.25	+5 4 47.4	+ 9.61	54 40.8	+0.1
	4	13 58 42.7	.5824386	337 11 0.0	7 16.09	+5 5 22.5	+ 9.30	54 39.9	+0.1
	25	10 42 9.5	.4459431	254 42 56.2	. . . . .	−0 30 54.5	. . . . .	57 40.1	. . .
	27	12 17 38.2	.5122476	281 58 46.4	7 47.50	+1 53 55.0	+39.08	56 38.4	+3.8
	27	13 4 12.2	.5445856	282 23 57.9	7 47.22	+1 56 1.1	+38.97	56 37.5	+3.8
	27	15 48 17.2	.6585324	283 52 38.4	7 46.44	+2 3 22.5	+38.44	56 34.1	+3.8
	28	10 23 25.8	.4329374	293 51 11.9	. . . . .	+2 50 32.3	. . . . .	56 10.5	. . .
Aug.	8	20 10 5.2	.8403380	72 53 58.9	7 38.32	+0 34 59.1	−40.69	56 18.4	+2.0
	8	21 24 9.2	.8917732	73 33 17.5	7 39.04	+0 31 29.5	−40.81	56 20.9	+2.0
	22	8 59 12.4	.3744485	264 1 9.1	. . . . .	+0 29 27.1	. . . . .	57 12.3	. . .
	22	14 25 21.9	.6009480	65 41 20.1	7 21.76	+0 58 15.3	−38.24	55 19.6	. . .
Sept.	4	13 17 39.8	.5539329	65 6 44.5	7 21.25	+1 1 14.7	+38.09	55 17.9	+1.2
	23	7 1 24.5	.2926447	323 11 9.8	7 18.23	+4 39 19.2	+14.29	54 44.8	+4.7
	24	9 58 31.0	.4156366	336 46 57.2	7 13.50	+4 57 51.7	+ 5.38	54 22.6	+4.7
Dec.	14	4 55 47.9	.2054155	323 20 29.4	7 35.60	+5 0 40.2	+13.22	55 55.8	+2.8
1826, Jan.	13	5 23 42.8	.2248010	356 4 23.6	7 16.80	+4 59 5.7	−10.16	54 43.8	+3.7
Feb.	15	7 27 0.4	.3104213	64 25 49.4	7 13.84	+0 20 43.7	−38.30	54 50.3	+4.2
	16	4 44 11.9	.1973600	75 12 48.1	7 21.93	−0 36 24.7	−38.79	55 19.6	+4.1
May	12	9 10 21.6	.3821945	115 58 46.4	7 35.36	−4 15 0.2	−24.95	55 58.4	+3.5
	13	8 38 18.0	.3599306	128 29 44.5	7 46.67	−4 49 54.5	−17.50	56 39.1	+3.7
July	27	11 58 7.5	.4986979	46 26 30.1	7 4.94	+1 14 39.9	−36.78	54 14.7	+0.7
Sept.	13	10 39 34.9	.4441539	323 7 58.0	7 53.15	+5 2 49.3	+ 2.00	56 48.3	+2.8
	21	10 8 44.0	.4227315	61 25 32.2	7 3.97	−0 34 7.4	−37.82	54 9.4	+1.1
Oct.	24	15 31 20.8	.6467686	133 23 53.4	7 45.57	−5 10 41.1	− 7.67	56 34.9	+0.7
1827, Jan.	5	10 37 15.1	.4425360	25 0 36.1	7 12.76	+2 21 35.7	−34.48	54 44.0	+2.4
	14	9 28 22.6	.3947062	132 51 51.2	7 36.71	−4 59 57.2	− 6.00	55 46.2	+1.2
	14	10 34 24.3	.4405591	133 26 46.0	7 36.98	−5 0 23.8	− 5.59	55 47.4	+1.2
	19	14 53 29.1	.6204758	201 49 48.0	8 14.50	−2 28 3.4	−38.27	58 26.6	−0.4
Feb.	10	12 4 10.2	.5028960	130 21 5.3	7 40.77	−4 56 55.5	− 5.88	56 0.3	+1.7
July	2	8 51 30.6	.3691043	197 12 1.8	8 6.90	−2 12 2.8	+39.24	58 1.8	+3.0
	2	9 3 13.8	.3772430	197 18 36.8	8 6.90	−2 11 30.9	+39.28	58 2.2	+3.0
	7	11 1 34.6	.4594284	270 57 30.9	9 7.25	+3 48 4.6	+31.98	61 14.3	+1.0
Aug.	1	8 20 35.7	.3476353	234 31 36.3	8 28.30	+1 15 58.9	+43.37	59 17.3	+2.2
	29	6 21 50.0	.2651619	243 56 52.7	8 24.50	+2 17 23.8	+40.10	59 1.8	+2.5
Oct.	12	14 28 44.9	.6032976	109 37 49.3	7 8.74	−5 4 19.8	−10.64	54 18.9	+0.7
Nov.	16	5 1 40.2	.2094930	201 20 31.2	8 19.93	−1 16 22.6	+44.68	58 40.4	+0.2
	28	10 3 19.4	.4189745	14 37 44.6	7 39.96	+1 49 51.9	−39.38	56 18.8	+1.8
Dec.	8	15 59 41.7	.6664549	138 41 1.4	7 11.73	−4 59 48.7	+ 9.53	54 26.6	+0.7
	8	17 21 53.2	.7235325	139 22 6.0	7 11.89	−4 58 52.7	+ 9.98	54 27.9	+0.7
1828, Jan.	31	11 24 55.6	.4756436	130 17 4.6	7 11.64	−4 54 26.7	+ 7.07	54 11.5	+1.2
Feb.	22	7 31 7.2	.3132777	65 22 34.8	7 17.50	−3 8 23.6	−30.83	55 0.0	+1.5
Mar.	23	8 4 50.6	.3366968	97 42 33.5	7 8.53	−4 58 27.1	−12.32	54 18.7	+2.1
	24	9 12 3.7	.3833761	110 8 38.2	7 7.28	−5 12 52.3	− 4.12	54 11.3	+2.1
	24	10 19 35.4	.4302708	110 42 1.9	7 7.30	−5 13 10.7	− 3.70	54 11.2	+2.1
	31	11 58 54.0	.4992361	198 5 28.2	8 30.55	−0 43 13.2	+46.48	56 56.8	−0.6
June	16	8 19 38.3	.3469710	133 53 18.4	7 6.40	−4 45 29.9	+12.93	54 3.2	+1.8
Aug.	16	12 6 59.8	.5048589	214 32 2.3	7 38.89	+1 2 54.7	+39.48	56 20.1	+2.2
	28	9 23 36.5	.3913948	25 22 15.0	8 17.58	−0 42 32.7	−44.59	58 38.0	−1.1
1829, Jan.	18	8 49 27.5	.3676795	105 47 56.6	7 19.29	−4 59 47.3	+ 3.53	54 40.7	+2.9
Apr.	12	5 51 6.3	.2438229	130 53 5.9	7 9.10	−4 24 54.0	+21.70	54 21.6	+2.8
June	13	10 36 20.4	.4419029	221 34 27.8	7 37.40	+3 3 10.3	+31.98	56 3.4	+1.7
	13	10 55 17.2	.4550601	221 44 28.6	7 37.50	+3 3 52.4	+31.99	56 4.0	+1.7
	13	11 37 36.1	.4844456	222 6 54.6	7 37.88	+3 5 26.2	+31.81	56 5.2	+1.7
July	26	12 13 17.4	.5092291	80 13 25.0	7 46.90	−5 0 57.3	− 7.18	56 50.0	−1.2
Aug.	8	12 0 0.0	.5000000	238 28 52.0	7 39.02	+4 26 39.9	+21.23	56 13.8	+1.8
	21	13 0 0.0	.5416667	64 30 32.6	8 0.10	−4 45 45.3	−18.01	57 28.5	+1.8
	21	15 24 0.0	.6416667	65 50 28.5	7 58.91	−4 48 41.1	−17.01	57 23.8	+1.8
	21	16 36 0.0	.6916667	66 30 21.9	7 58.32	−4 50 5.4	−16.53	57 21.5	+1.8
	21	17 48 0.0	.7416667	67 10 12.2	7 57.74	−4 51 27.2	−16.06	57 19.2	+1.8
	21	20 12 0.0	.8416667	68 29 44.0	7 56.57	−4 54 3.4	−15.08	57 14.7	+1.8
Sept.	18	2 3 49.8	.0859930	67 54 56.6	8 9.83	−4 57 50.4	−15.82	58 2.4	−1.6
	23	21 4 14.0	.8779398	140 55 22.1	7 9.35	−3 14 36.9	+31.41	54 18.5	+0.2
	23	21 40 53.0	.9033912	141 13 34.7	7 9.29	−3 13 6.7	+31.53	54 18.1	+0.2
Oct.	15	9 4 58.5	.3784549	66 41 27.4	8 27.38	−4 52 51.7	−17.00	58 58.6	−0.6
	15	9 48 58.6	.4090117	67 7 17.0	8 26.86	−4 53 43.4	−16.72	58 56.9	−0.6
Nov.	11	21 50 51.7	.9103208	67 59 20.2	8 34.69	−4 49 34.9	−15.02	59 17.4	+0.2
	11	22 31 13.7	.9383532	68 23 22.8	8 34.40	−4 50 16.7	−14.71	59 16.1	+0.2
Dec.	9	5 46 18.3	.2404894	66 41 55.3	8 30.90	−4 45 58.0	−13.81	59 1.6	+2.0
	9	5 51 36.3	.2441702	66 45 3.7	8 31.01	−4 46 3.1	−13.70	59 1.5	+2.0
1830, Jan.	5	14 59 7.2	.6243889	67 26 58.7	8 17.73	−4 53 37.8	−10.83	58 18.7	+2.4

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in 0d.01.	Geocentric Latitude of Moon.	Motion in 0d.01.	Parallax	Δι.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1830, Jan. 5	15 43 32.4	.6552361	67 52 34.0	8 17.64	−4 54 10.9	−10.53	58 18.0	+2.4
Mar. 2	5 54 49.8	.2464096	83 0 13.1	8 1.50	−5 16 59.6	+ 2.81	57 30.1	+2.7
2	9 24 2.9	.3917002	84 56 36.8	7 59.70	−5 16 8.2	+ 4.35	57 24.0	+3.0
3	8 50 46.2	.3685903	97 49 3.0	7 49.12	−5 1 24.1	+13.59	56 44.8	+3.0
3	9 0 13.9	.3751609	97 54 10.2	7 49.10	−5 1 15.2	+13.73	56 44.6	+3.0
28	7 20 0.0	.3055556	65 56 11.0	8 33.70	−5 7 46.3	−10.76	59 22.4	+1.9
28	8 32 0.0	.3555556	66 38 57.9	8 32.92	−5 8 38.8	−10.17	59 19.8	+1.9
28	9 44 0.0	.4055556	67 21 40.9	8 32.14	−5 9 28.4	− 9.59	59 17.2	+1.9
28	10 56 0.0	.4555556	68 4 20.0	8 31.35	−5 10 15.1	− 9.02	59 14.5	+1.9
28	12 8 0.0	.5055556	68 46 55.1	8 30.55	−5 10 58.9	− 8.46	59 11.8	+1.9
29	7 4 43.9	.2949526	79 50 28.5	8 17.92	−5 16 8.9	+ 0.52	58 29.0	+2.1
29	7 49 55.3	.3263345	80 16 30.7	8 17.47	−5 16 6.6	+ 0.83	58 27.3	+2.1
Apr. 5	7 13 27.0	.3010070	168 15 13.0	7 7.64	−0 5 40.0	+39.26	54 13.3	+3.2
28	7 18 19.4	.3043912	115 49 48.6	7 49.53	−4 4 19.4	+25.71	56 54.4	+2.7
28	7 28 0.9	.3111215	115 55 4.0	7 49.50	−4 4 12.1	+25.81	56 54.0	+2.7
May 1	11 13 3.7	.4674040	155 16 47.0	7 13.11	−1 8 36.6	+37.96	54 44.5	+3.3
1	11 28 59.7	.4784687	155 24 45.2	7 13.00	−1 7 54.6	+38.03	54 44.2	+3.3
June 4	10 10 42.5	.4241030	234 42 59.9	7 17.80	+4 41 42.9	+13.25	54 38.6	+1.5
25	8 22 30.5	.3489641	158 13 8.9	7 24.40	−0 24 7.0	+39.36	55 26.7	+2.8
July 15	22 17 53.2	.9290879	66 47 19.9	8 31.78	−5 6 43.1	− 3.69	59 9.3	−1.0
16	0 14 18.7	.0099386	67 56 17.6	8 31.60	−5 7 9.0	− 2.72	59 8.2	−1.1
Aug. 1	9 8 15.4	.3807338	275 55 15.0	7 46.80	+4 42 23.0	−17.95	56 29.7	+0.7
Sept. 5	8 31 20.4	.3550971	22 40 30.4	8 50.62	−3 34 15.5	−36.08	60 21.8	−2.4
5	9 14 11.4	.3848540	23 6 49.3	8 50.57	−3 36 2.7	−35.79	60 21.5	−2.4
Oct. 4	14 28 17.2	.6029767	50 34 14.2	8 57.75	−4 54 48.0	−16.09	60 41.0	−1.7
4	14 51 49.2	.6193193	50 48 52.9	8 57.59	−4 55 14.2	−15.84	60 40.5	−1.7
5	14 20 0.0	.5972222	65 16 43.8	8 46.64	−5 11 18.9	− 3.79	60 4.8	−1.9
5	16 44 0.0	.6972222	66 44 24.3	8 45.28	−5 11 50.9	− 2.57	60 0.5	−1.9
20	4 32 13.7	.1890475	249 1 18.8	7 9.71	+5 7 6.3	+ 0.05	54 12.4	+1.7
20	4 39 34.3	.1941470	249 4 57.7	7 9.70	+5 7 6.4	+ 0.01	54 12.5	+1.7
23	5 51 22.0	.2440046	286 8 55.0	7 28.60	+4 4 43.5	−24.22	55 37.3	+2.6
30	5 23 42.1	.2247928	22 43 15.2	9 8.13	−3 32 19.9	−34.82	61 18.1	+0.2
Nov. 4	13 39 51.6	.5693472	102 40 56.1	8 24.04	−4 10 23.5	+25.29	58 54.1	−1.1
Dec. 22	4 4 36.5	.1698670	356 52 47.7	8 12.80	−2 3 45.7	−40.02	58 22.7	+2.5
27	9 46 5.3	.4070058	72 33 8.8	8 56.70	−5 0 8.4	+ 8.10	60 31.6	−2.2
1831, Jan. 20	7 39 8.6	.3188495	23 32 44.5	8 24.76	−4 7 45.9	−28.00	58 56.7	+2.0
20	7 47 54.6	.3249376	23 37 50.7	8 24.80	−4 8 2.9	−28.03	58 56.8	+2.0
21	10 39 10.8	.4438749	39 25 35.6	8 31.38	−4 50 39.5	−17.19	59 16.3	+2.5
21	11 54 13.8	.4959931	40 10 1.7	8 31.69	−4 52 8.2	−16.69	59 17.1	+2.5
22	6 49 50.3	.2846100	51 25 6.4	8 35.50	−5 8 28.7	−79.92	59 27.3	+3.6
26	10 15 16.6	.4272755	110 52 3.2	8 29.13	−3 22 45.4	+35.41	59 2.3	+2.2
28	17 11 57.3	.7166355	142 32 7.4	8 5.00	−0 36 19.8	+44.01	57 42.8	+1.4
Feb. 4	22 22 22.1	.9322004	232 13 53.1	7 7.30	+5 12 20.5	+ 6.00	54 12.9	+1.0
4	23 47 29.2	.9913104	232 55 59.1	7 7.35	+5 12 54.6	+ 5.51	54 13.0	+1.0
19	6 45 23.4	.2815210	62 22 51.0	8 30.63	−5 17 8.9	+ 1.19	59 11.3	+2.8
19	7 12 58.2	.3006736	62 39 7.7	8 30.60	−5 17 6.5	+ 1.39	59 11.2	+2.8
19	9 17 5.3	.3868669	63 52 27.8	8 30.40	−5 16 50.2	+ 2.46	59 10.5	+2.8
19	12 15 32.3	.5107905	65 37 22.3	8 30.10	−5 16 11.7	+ 3.78	59 9.5	+2.8
19	16 27 53.2	.6860324	68 6 47.5	8 29.58	−5 14 47.2	+ 5.81	59 7.9	+2.8
20	11 52 17.6	.4946481	79 31 59.5	8 27.04	−5 0 48.1	+14.76	58 59.0	+2.9
Apr. 15	5 5 42.5	.2122975	67 43 39.8	8 55.01	−5 2 19.4	+ 6.90	60 31.0	+1.8
May 22	12 30 57.4	.5214977	201 8 16.0	7 13.73	+4 6 27.4	+21.66	54 31.2	+2.0
June 21	9 12 3.1	.3833692	232 18 57.6	7 7.28	+5 5 20.6	+ 0.65	54 1.8	+1.1
21	9 50 22.3	.4099804	232 37 53.8	7 7.30	+5 5 22.1	+ 0.45	54 1.6	+1.1
July 31	12 26 37.3	.5184872	35 2 51.7	8 24.43	−5 2 50.3	−13.29	58 51.1	−1.8
Aug. 28	21 3 28.2	.8774096	51 2 44.8	8 29 68	−5 16 2.4	− 0.55	59 6.8	−2.2
29	16 40 0.0	.6944444	62 38 6.0	8 31.47	−5 10 22.1	+ 8.82	59 14.3	−1.8
29	19 4 0.0	.7944444	64 3 21.5	3 31.58	−5 8 47.9	+ 9.95	59 15.1	−1.8
29	21 28 0.0	.8944444	65 28 38.6	8 31.76	−5 7 2.2	+11.06	59 15.7	−1.8
30	1 12 35.4	.0504096	67 41 42.0	8 31.96	−5 3 54.7	+12.88	59 16.7	...
Oct. 14	12 54 13.2	.5376528	302 33 53.3	7 19.47	+1 30 48.6	−37.40	55 10.4	+0.4
21	8 36 10.1	.3584502	34 38 4.6	8 51.36	−4 52 19.8	−11.70	60 12.2	−1.5
21	9 28 14.1	.3946076	35 10 5.9	8 51.56	−4 53 1.9	−11.32	60 13.0	−1.5
23	9 30 0.0	.3958333	64 54 10.1	8 54.67	−4 50 30.8	+12.85	60 28.1	−1.8
23	10 42 0.0	.4458333	65 38 43.0	8 54.49	−4 49 24.9	+13.38	60 27.7	−1.8
23	11 54 0.0	.4958333	66 23 15.2	8 54.30	−4 48 16.3	+13.94	60 27.3	−1.8
23	13 6 0.0	.5558333	67 7 46.3	8 54.10	−4 47 4.7	+14.52	60 26.8	−1.8
23	13 32 45.1	.5644109	67 24 19.4	8 53.90	−4 46 37.4	+14.90	60 26.6	−1.8
23	14 18 0.0	.5958333	67 52 16.4	8 53.88	−4 45 50.3	+15.12	60 26.3	−1.8
23	14 27 53.8	.6027060	67 58 24.2	8 53.90	−4 45 39.8	+15.20	60 26.3	−1.8

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in 0^d.01.	Geocentric Latitude of Moon.	Motion in 0.^d01.	Parallax.	Δv.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1831, Nov. 8	5 32 1.0	.2305671	271 20 48.0	7 5.79	+3 35 33.6	−25.99	54 1.1	+0.6
16	11 27 1.8	.4771042	15 15 33.4	8 32.27	−4 17 28.4	−23.24	59 16.3	+0.4
24	11 11 37.4	.4664051	133 32 50.4	8 21.32	−0 10 48.3	+44.33	58 55.0	−1.2
Dec. 17	3 34 4.2	.1486597	62 40 55.5	9 5.90	−4 50 43.1	+15.90	61 6.0	+1.2
17	3 36 59.3	.1506863	62 42 46.6	9 5.96	−4 50 39.9	+15.88	61 6.0	+1.2
18	7 11 26.1	.2996076	80 14 35.5	9 12.17	−4 6 49.3	+29.44	61 28.8	+0.7
1832, Jan. 5	3 41 27.5	.1537905	311 51 42.4	7 13.80	+0 3 58.9	−39.70	54 36.3	+0.2
Feb. 10	5 5 40.3	.2122720	67 10 15.3	8 32.50	−4 48 35.7	+19.70	59 21.1	+2.7
10	6 10 27.4	.2572615	67 48 42.6	8 33.00	−4 47 6.0	+20.20	59 22.6	+2.7
15	4 57 50.1	.2068298	140 6 38.4	8 45.06	+0 41 56.7	+48.05	60 3.9	+1.7
15	17 13 48.2	.7179190	147 32 13.6	8 40.99	+1 22 16.2	+46.45	59 49.3	+1.7
15	17 17 11.5	.7202720	147 34 16.1	8 41.10	+1 22 27.2	+46.40	59 49.2	+1.7
Mar. 8	8 56 1.8	.3722431	66 6 35.2	8 24.70	−4 44 27.5	+18.70	58 52.6	+2.8
8	12 6 10.9	.5042928	67 57 44.0	8 25.21	−4 40 11.7	+19.96	58 55.0	+2.8
9	11 5 11.9	.4619433	81 26 59.7	8 28.77	−4 0 37.6	+29.29	59 11.0	+2.9
9	11 6 35.9	.4629155	81 27 47.8	8 28.80	−4 0 34.8	+29.30	59 11.0	+2.9
9	11 41 3.9	.4868507	81 48 7.0	8 28.84	−3 59 24.3	+29.48	59 11.4	+2.9
Apr. 14	8 2 59.1	.3354062	200 50 35.2	7 52.79	+4 45 30.7	+13.16	56 45.3	+2.5
June 17	19 0 25.7	.7919640	321 4 16.8	7 9.01	−1 32 50.2	−37.35	54 25.0	−1.
17	19 43 14.5	.8216956	321 25 32.6	7 9.12	−1 34 41.2	−37.27	54 25.6	−1.
Sept. 4	8 11 10.8	.3410972	282 44 17.8	7 4.60	+1 47 48.1	−36.30	54 9.8	0.0
7	13 33 20.4	.5648194	320 59 11.6	7 13.33	−1 36 32.6	−37.21	54 32.5	−0.7
7	14 43 31.0	.6135532	321 34 24.0	7 13.66	−1 39 33.7	−37.11	54 33.4	−1.0
Dec. 31	8 36 28.2	.3586597	28 4 2.9	7 49.90	−5 16 31.4	+ 2.80	56 49.8	+1.8
1833, Mar. 31	7 8 43.8	.2977292	138 29 28.7	8 44.20	+2 20 42.3	+40.80	60 5.8	+4.7
Dec. 26	4 47 38.6	.1997522	92 13 39.9	8 19.57	−0 20 51.4	+46.12	58 33.9	+1.1
1834, Apr. 13	7 54 36.0	.3295833	75 14 50.0	7 30.80	−1 11 1.4	+38.80	55 45.7	+2.8
20	8 40 52.2	.3617153	171 25 40.2	8 58.40	+5 2 19.1	+ 5.80	60 42.0	+5.4
Aug. 12	7 3 10.8	.2938749	240 42 1.0	8 14.19	+2 8 6.1	−40.16	58 25.8	+5.1
12	8 3 58.3	.3360913	241 16 46.8	8 13.85	+2 5 16.0	−40.31	58 24.4	+5.1
30	16 23 47.0	.6831835	111 6 57.9	8 10.91	+2 18 45.9	+38.46	58 10.0	+1.8
Oct. 7	5 32 8.3	.2306516	259 50 6.1	8 19.30	+0 0 2.9	−44.40	58 47.1	+2.8
7	5 56 8.2	.2473171	260 3 58.5	8 18.98	−0 1 11.0	−44.32	58 46.2	+2.8
7	6 6 8.8	.2542685	260 9 44.8	8 18.90	−0 1 41.7	−44.30	58 45.8	+2.8
8	6 40 59.5	.2784664	274 7 26.9	8 2.74	−1 15 20.6	−41.58	57 49.3	+2.7
8	6 50 38.9	.2851724	274 12 50.0	8 2.70	−1 15 48.5	−41.50	57 49.0	+2.7
Nov. 3	4 10 5.1	.1736702	253 19 20.2	8 43.10	+0 25 8.8	−47.30	60 3.0	+2.4
Dec. 17	13 50 30.0	.5767360	107 36 3.9	7 44.71	+2 39 8.5	+37.05	56 25.6	...
17	15 9 21.6	.6315001	108 18 29.8	7 45.07	+2 42 31.0	+36.84	56 27.2	...
1835, Jan. 6	9 45 19.2	.4064722	15 58 46.2	7 7.90	−4 35 10.5	+18.70	54 18.4	+0.1
18	12 4 28.9	.5031122	170 38 30.1	8 26.54	+5 8 38.5	− 3.14	58 52.3	+0.8
18	12 51 59.4	.5361039	171 6 21.7	8 26.64	+5 8 27.6	− 3.54	58 52.7	+0.8
Apr. 9	8 39 14.4	.3605833	151 48 52.6	8 27.10	+5 4 42.4	+ 6.10	58 57.1	+5.1
June 10	9 41 57.4	.4041365	258 35 59.8	8 58.00	−0 56 49.1	−48.80	60 49.7	+2.5
12	11 14 11.4	.4681872	288 55 56.5	8 37.26	−3 26 38.4	−36.09	59 35.5	+0.8
14	11 34 41.6	.4824262	317 1 59.2	8 6.47	−4 55 7.6	−16.08	57 46.6	−0.7
July 6	10 0 32.1	.4170382	238 10 20.7	8 45.50	+0 52 46.7	−47.10	60 11.8	+4.2
Aug. 6	5 38 32.7	.2351006	288 31 50.4	8 28.93	−3 25 3.1	−33.11	59 2.6	+2.9
6	5 45 58.7	.2402625	288 36 13.2	8 28.93	−3 25 20.1	−33.07	59 2.4	+2.9
6	6 59 52.6	.2915815	289 19 44.4	8 28.64	−3 28 8.7	−32.64	59 1.3	+2.9
8	9 39 52.7	.4026934	318 44 43.6	8 12.62	−4 49 7.4	−12.58	57 56.8	+0.6
29	5 51 30.2	.2440995	228 35 48.4	8 30.60	+1 17 56.6	−43.50	59 23.1	+5.6
Oct. 3	6 22 35.0	.2656829	335 27 48.9	7 46.80	−5 5 35.4	+ 3.60	56 26.5	+1.4
29	5 42 39.0	.2379510	319 1 8.0	7 56.42	−5 9 42.5	− 7.89	57 12.4	+2.0
Nov. 25	6 13 1.9	.2590498	315 31 22.5	8 12.60	−5 8 57.8	−10.70	58 11.3	+0.8
27	10 11 58.7	.4249853	344 10 46.6	7 41.29	−5 7 19.0	+10.98	56 19.4	...
1836, Feb. 8	11 6 55.6	.4631436	214 56 25.1	8 16.46	+1 44 6.9	−41.07	58 33.9	+1.5
23	5 35 44.2	.2331504	55 59 18.4	7 7.90	+0 12 45.6	+37.80	54 27.8	−0.4
25	8 11 50.9	.3415613	80 54 21.3	7 5.40	+2 19 30.6	+33.40	54 14.7	+0.6
Mar. 24	5 10 34.9	.2156817	87 13 41.3	7 5.60	+3 2 47.3	+31.00	54 14.7	+1.0
Apr. 25	8 26 14.4	.3515555	145 29 34.9	7 36.82	+5 14 59.6	− 3.92	56 1.1	+4.1
25	8 43 14.3	.3633600	145 38 33.3	7 36.90	+5 14 55.0	− 4.00	56 1.7	+4.1
25	9 1 23.2	.3759629	145 48 10.4	7 37.22	+5 14 49.8	− 4.13	56 2.2	+4.1
May 17	7 33 46.2	.3151180	81 12 24.7	7 5.65	+2 44 12.1	+33.58	54 1.7	−0.6
June 28	13 2 4.6	.5431078	278 29 30.2	9 9.97	−3 53 52.1	−31.95	61 22.6	+2.3
Aug. 22	6 32 33.0	.2726032	277 27 28.3	8 45.90	−4 2 33.2	−27.59	60 5.6	+4.5
22	7 56 23.5	.3308276	278 18 31.7	8 46.33	−4 5 12.1	−27.03	60 6.6	+4.5
Sept. 16	8 40 10.2	.3612291	246 44 26.3	8 22.00	−2 9 40.7	−41.01	58 51.8	+6.1
16	8 45 26.7	.3648924	246 47 30.1	8 21.97	−2 9 55.7	−41.01	58 51.9	+6.1
16	8 47 32.7	.3663507	246 48 43.3	8 21.95	−2 10 1.7	−41.00	58 51.9	+6.1

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in 0d.01.	Geocentric Latitude of Moon.	Motion in 0d.01.	Parallax.	Jr.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1836, Sept. 21	8 12 51.6	.3422639	317 35 30.0	8 35.73	−5 7 7.8	+ 4.64	59 21.6	+3.3
Oct. 21	8 34 23.7	.3572183	355 38 14.3	8 7.46	−3 45 3.2	+31.44	57 46.8	+1.7
21	10 47 57.0	.4499651	356 53 32.0	8 6 73	−3 40 8.6	+32.06	57 44.3	+1.7
21	12 0 28.1	.5003249	357 34 22.1	8 6.34	−3 37 26.0	+32.46	57 42.9	+1.7
Dec. 16	8 31 39.1	.3553138	15 39 8.6	7 44.73	−2 8 39.1	+38.20	56 40.4	...
1837, Feb. 14	6 57 52.1	.2901864	82 31 49.0	7 9.40	+3 45 35.8	+25.20	54 23.7	+0.2
17	9 36 43.6	.4005045	119 25 40.6	7 7.82	+5 1 4.8	+ 2.99	54 1.4	+1.2
Mar. 12	6 13 8.8	.2591297	66 8 39.9	7 26.42	+2 53 6.2	+33.51	55 33.1	+0.3
13	9 39 4.1	.4021308	80 8 43.1	7 16.00	+3 50 23.5	+26.40	54 52.3	+0.9
15	9 0 43.5	.3755035	103 45 32.4	7 7.40	+4 54 31.2	+12.20	54 12.4	+1.1
16	6 53 18.3	.2870174	114 33 51.5	7 6.80	+5 7 42.5	+ 5.10	54 6.5	+1.5
May 10	9 21 40.7	.3900544	119 47 23.9	7 8.50	+5 14 45.6	+ 1.10	54 14.8	+1.4
June 6	8 3 44.3	.3359294	115 21 25.5	7 10.50	+5 6 15.4	+ 3.50	54 14.6	+0.1
16	6 29 40.7	.2706105	239 41 2.3	8 29.31	−2 30 29.1	−39.51	59 9.3	+5.1
July 9	6 47 8.9	.2827420	182 51 5.6	7 17.98	+2 8 6.5	−34.91	55 2.4	+4.3
Aug. 18	10 6 59.2	.4215186	3 25 34.4	8 43.94	−1 47 59.1	+43.61	60 5.3	−1.2
18	11 11 14.2	.4661367	4 4 30.5	8 43.15	−1 44 44.2	+43.71	60 3.1	−1.2
Oct. 9	6 36 46.4	.2755371	319 10 9.8	8 43.78	−4 43 15.0	+21.51	59 56.6	+4.3
9	7 47 38.7	.3247536	319 53 8.3	8 44.05	−4 41 27.3	+22.05	59 57.6	+4.3
Nov. 5	6 32 6.4	.2722963	315 27 2.3	8 30.30	−4 49 49.9	+18.24	59 12.8	+5.2
10	8 9 6.2	.3396551	27 17 14.1	8 23.00	+0 26 56.2	+45.90	58 47.3	+1.3
12	12 41 2.0	.5284954	57 21 44.9	8 4.81	+3 0 0.5	+36.09	57 36.6	−0.7
1838, Jan. 3	3 8 27.0	.1308681	17 21 19.5	8 13.60	−0 5 53.4	+43.50	58 3	+2.0
Feb. 2	9 8 0.8	.3805652	57 40 34.1	7 49.40	+3 25 23.0	+30.77	56 54.4	...
4	7 6 31.9	.2962025	82 9 50.2	7 32.10	+4 40 8.8	+15.60	55 40.9	+0.5
7	7 49 28.9	.3260289	119 25 41.3	7 15.10	+4 54 29.9	− 9.60	54 26.6	+0.8
Mar. 1	4 33 12.0	.1897222	51 16 33.2	8 9.00	+3 11 33.8	+35.20	58 7.0	+0.3
29	4 14 34.0	.1767824	59 33 24.4	8 15.67	+3 50 14.1	+31.46	58 24.2	+0.6
June 4	7 52 56.7	.3284340	213 23 9.4	7 25.60	−1 54 35.7	−36.70	55 22.5	+5.2
July 31	9 16 19.2	.3863333	242 43 53.4	7 42.27	−4 16 28.8	−22.45	56 23.8	+6.2
Aug. 12	13 45 22.4	.5731755	56 18 22.6	8 8.20	+4 1 6.4	+27.59	58 0.1	−2.6
12	14 47 54.9	.6166081	56 53 42.3	8 7.76	+4 3 5.3	+27.17	57 58.1	−2.6
12	15 36 57.2	.6506624	57 21 22.9	8 7.43	+4 4 37.2	+26.86	57 56.7	−2.6
Sept. 2	6 54 7.8	.2875903	319 2 44.4	8 55.80	−3 43 43.2	+34.40	60 36.5	+3.2
8	8 4 2.0	.3361343	49 5 17.4	8 28.70	+3 43 16.9	+33.13	59 12.7	−2.5
Oct. 5	12 47 34.5	.5330387	46 14 53.2	8 48.68	+3 33 3.7	+36.22	60 16.1	−2.3
25	7 4 51.8	.2950440	294 43 29.0	8 1.80	−4 53 21.0	+15.60	57 33.5	+5.6
25	7 8 16.7	.2974155	294 45 24.4	8 1.80	−4 53 17.3	+15.63	57 33.6	+5.6
Nov. 3	6 49 41.5	.2845081	65 14 53.2	8 41.33	+4 33 39.8	+22.39	59 43.6	−1.9
27	4 49 27.6	.2010138	13 43 51.7	8 42.20	+1 1 5.6	+45.50	60 1.2	+2.9
29	9 43 9.2	.4049674	45 56 36.6	8 47.15	+3 30 42.7	+33.53	60 5.4	+0.9
Dec. 26	5 7 59.5	.2138831	38 28 43.2	8 31.20	+3 11 11.5	+34.60	59 17.6	+2.4
26	5 8 12.6	.2140347	38 28 52.7	8 31.13	+3 11 12.1	+34.61	59 17.6	+2.4
1839, Apr. 20	15 28 40.7	.6449155	125 34 22.0	7 39.68	+3 55 39.8	−27.45	56 19.3	+0.4
May 2	12 41 25.9	.5287720	268 49 25.4	7 26.46	−5 6 14.5	+ 3.47	55 16.2	+2.5
6	13 16 34.7	.5524848	320 44 18.9	8 6.93	−2 47 0.4	+36.67	58 0.4	+2.1
24	4 2 2.6	.1680857	201 10 39.8	7 4.67	−2 25 41.5	−32.94	54 2.8	...
24	4 18 3.2	.1792035	201 18 32.0	7 4.66	−2 26 18.0	−32.86	54 2.7	...
June 19	13 0 27.4	.5419838	190 18 7.0	7 6.98	−1 46 27.9	−35.26	54 21.1	+2.2
20	13 7 31.2	.5468889	202 11 36.6	7 5.28	−2 42 39.1	−31.55	54 11.3	+2.6
20	13 54 30.9	.5795243	202 34 44.7	7 5.32	−2 44 22.0	−31.42	54 11.1	+2.6
23	13 50 0.0	.5763889	238 18 35.6	7 16.30	−4 41 5.3	−13.62	54 36.2	+3.9
24	6 49 34.6	.2844283	246 56 16.2	7 21.09	−4 54 3.2	− 8.21	54 51.4	+3.8
July 1	18 42 7.9	.7792581	344 32 13.0	8 14.19	−0 19 48.0	+43.76	58 24.9	+3.0
1	19 54 49.6	.8297407	345 13 48.1	8 14.50	−0 16 7.1	+43.80	58 26.2	+3.0
6	21 13 51.2	.8846203	56 46 5.4	8 40.42	+4 43 3.8	+16.59	59 41.8	−2.2
6	21 41 43.2	.9039722	57 2 52.6	8 40.46	+4 43 35.8	+16.45	59 41.8	−2.2
23	8 50 33.8	.3684468	268 44 29.3	7 35.90	−5 1 3.1	+ 8.30	55 47.4	+4.4
Aug. 17	8 58 55.2	.3742504	239 51 40.5	7 11.60	−5 2 30.2	−11.04	54 29.4	+3.9
17	9 31 9.1	.3966336	240 7 46.9	7 11.69	−5 2 54.6	−10.84	54 29.9	+3.9
25	8 32 4.4	.3556065	344 31 51.2	8 35.10	−0 7 28.3	+47.50	59 30.1	+1.5
Sept. 11	11 26 31.2	.4767500	213 31 59.2	7 7.07	−3 54 35.2	−26.42	54 8.8	+1.8
26	9 8 29.8	.3809001	52 53 18.1	8 50.12	+4 50 36.6	+18.78	60 17.0	−2.3
26	15 0 0.0	.6250000	56 28 32.3	8 47.87	+4 57 42.0	+15.90	60 9.8	−2.3
26	16 12 0.0	.6750000	57 12 31.4	8 47.40	+4 59 0.1	+15.35	60 8.2	−2.3
26	17 24 0.0	.7250000	57 56 27.6	8 46.98	+5 0 15.4	+14.74	60 6.6	−2.3
Oct. 17	13 26 21.2	.5599676	321 31 59.7	8 5.37	−2 5 34.6	+40.26	57 55.4	+4.1
18	10 55 56.9	.4555197	333 47 36.9	8 20.46	−1 2 9.3	+44.46	58 48.0	+3.4
18	10 59 11.6	.4577731	333 49 28.7	8 20.40	−1 1 59.4	+44.40	58 48.2	+3.4
19	5 19 59.9	.2222210	344 35 23.9	8 33.50	−0 3 53.8	+46.50	59 31.6	+2.7

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	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1839, Oct. 19	8 41 40.6	.3622754	346 35 30.9	8 35.80	+0 6 58.6	+46.70	59 39.2	+2.7
28	19 16 32.2	.8031504	124 49 58.7	7 56.16	+3 17 36.3	−32.71	57 21.5	−3.3
Nov. 14	7 11 58.5	.2999827	326 48 56.1	7 55.30	−1 25 46.8	+40.40	57 23.3	+4.5
19	20 37 22.9	.8592928	46 52 10.9	9 12.04	+4 30 50.3	+21.01	61 26.3	−1.0
20	11 0 0.0	.4580000	56 3 55.0	9 12.91	+4 48 18.3	+13.73	61 27.5	−0.8
20	12 13 0.0	.5083333	56 49 59.8	9 12.89	+4 49 25.9	+13.20	61 25.1	−0.8
20	13 24 0.0	.5583333	57 36 4.4	9 12.80	+4 50 30.2	+12.50	61 26.9	−0.8
Dec. 12	6 44 41.2	.2810324	336 14 8.6	7 53.40	−0 20 7.4	+41.70	57 50.0	+4.6
12	13 23 20.9	.5578808	339 53 20.9	7 56.68	−0 0 48.4	+42.02	57 27.0	+4.6
12	14 33 22.0	.6065047	340 32 0.0	7 57.24	+0 2 36.2	+42.08	57 29.2	+4.6
1840, Jan. 11	3 35 11.8	.1494421	11 48 0.4	8 15.95	+2 54 8.5	+36.78	58 30.5	+3.7
11	4 42 6.1	.1959039	12 26 25.7	8 16.30	+2 56 59.0	+36.53	58 32.0	+3.7
13	7 34 59.3	.3159641	42 15 29.9	8 35.90	+4 39 22.6	+19.66	59 32.1	+2.6
13	7 51 34.1	.3274781	42 25 22.2	8 36.00	+4 39 45.2	+19.50	59 32.4	+2.6
13	8 29 35.2	.3538796	42 48 6.7	8 36.22	+4 40 36.5	+19.23	59 33.0	+2.6
14	8 52 32.4	.3698194	57 28 49.3	8 43.60	+5 4 1.3	+ 8.03	59 53.6	+2.6
14	9 5 55.4	.3791134	57 36 54.9	8 43.70	+5 4 8.8	+ 8.00	59 53.8	+2.6
14	9 23 29.6	.3913148	57 47 33.9	8 43.70	+5 4 18.5	+ 7.80	59 54.0	+2.6
14	9 29 23.6	.3954120	57 51 8.4	8 43.70	+5 4 21.7	+ 7.80	59 54.1	+2.6
14	9 51 42.8	.4109120	58 4 41.5	8 43.80	+5 4 33.6	+ 7.55	59 54.3	+2.6
14	10 1 14.4	.4175277	58 10 26.9	8 43.80	+5 4 38.7	+ 7.50	59 54.4	+2.6
16	6 10 11.1	.2570730	85 7 16.5	8 45.55	+4 53 57.3	−14.43	60 5.6	+0.8
16	6 11 2.8	.2576713	85 7 47.4	8 48.60	+4 53 56.4	−14.40	60 5.6	+0.8
16	7 50 59.3	.3270753	86 8 56.6	8 48.46	+4 52 13.0	−15.21	60 5.2	+0.8
20	14 17 14.0	.5953010	146 56 14.7	8 7.28	+0 54 2.6	−43.51	57 53.7	−0.6
Feb. 15	10 33 2.6	.4396134	125 38 4.6	8 19.03	+2 42 38.5	−39.42	58 29.2	+0.8
15	11 13 0.9	.4673715	126 1 9.6	8 18.82	+2 40 49.0	−39.58	58 28.5	+0.8
26	11 13 26.1	.4676632	264 3 16.9	7 12.97	−5 2 24.1	+11.98	54 33.7	+3.4
Mar. 15	7 26 38.9	.3101725	146 51 33.5	7 55.58	+0 53 12.6	−43.11	57 10.2	+1.4
15	8 34 3.6	.3569862	147 28 39.2	7 55.20	+0 49 50.6	−43.14	57 8.9	+1.4
23	8 13 2.0	.3423843	246 38 30.4	7 7.54	−5 13 5.3	+ 0.27	54 9.4	+3.1
23	9 7 12.6	.3800070	247 5 18.5	7 7.41	−5 13 3.6	+ 0.60	54 9.5	+3.1
Apr. 11	9 58 16.6	.4144700	145 4 15.5	7 50.22	+0 57 12.4	−41.64	56 58.7	+1.2
11	10 5 23.8	.4204144	145 8 6.9	7 50.20	+0 56 51.8	−41.60	56 58.4	+1.2
13	7 46 50.1	.3241910	169 35 28.8	7 35.35	−1 14 7.3	−39.71	55 57.5	+1.6
16	8 17 2.2	.3451643	207 3 10.3	7 18.55	−3 59 57.0	−24.10	54 42.3	+2.7
19	20 20 41.4	.8477013	249 4 58.0	7 7.39	−5 3 57.4	+ 2.75	54 2.5	+3.5
19	21 13 21.2	.8842731	249 31 1.0	7 7.36	−5 3 46.7	+ 3.92	54 2.5	+3.5
May 6	14 4 23.2	.5863796	117 3 44.0	8 24.35	+3 0 13.2	−35.70	59 0.0	+0.7
8	8 30 56.6	.3548217	141 10 52.2	7 58.16	+1 4 42.4	−41.31	57 32.4	+1.2
9	9 17 3.5	.3868461	154 41 57.0	7 45.34	−0 6 28.8	−41.11	56 45.0	+1.0
18	10 40 12.0	.4445834	264 53 47.2	7 7.54	−4 36 38.0	+14.38	54 1.7	+3.2
19	11 52 48.0	.4950001	277 23 16.5	7 8.97	−4 4 58.7	+21.66	54 12.8	+3.4
19	13 29 41.7	.5622883	278 11 23.6	7 9.13	−4 2 31.4	+22.13	54 13.8	+3.4
20	10 37 13.6	.4425186	288 42 51.1	7 11.91	−3 25 59.6	+27.58	54 29.6	+3.2
20	12 1 46.0	.5012269	289 25 7.7	7 12.15	−3 23 16.8	+27.92	54 30.8	+3.2
22	13 59 14.8	.5828102	314 45 29.3	7 26.07	−1 28 16.2	+37.55	55 33.5	+3.0
22	15 20 35.2	.6392963	315 27 30.6	7 26.58	−1 24 43.5	+37.75	55 35.7	+3.0
June 12	14 18 5.5	.5958970	239 59 1.2	7 7.57	−5 1 37.6	+ 0.01	53 59.0	+3.4
July 10	15 3 11.8	.6272198	249 6 42.0	7 7.23	−5 3 36.1	+ 7.30	54 2.4	+3.8
10	15 52 27.7	.6614317	249 31 3.5	7 7.28	−5 3 10.6	+ 7.57	54 2.3	+3.8
Sept. 3	5 57 10.8	.2480417	249 6 16.5	7 8.60	−5 9 22.2	+ 8.00	54 17.7	+3.1
8	18 47 29.2	.7829769	316 1 44.0	7 34.23	−1 2 11.5	+40.91	55 53.5	+3.6
Oct. 6	13 43 10.0	.5716436	321 12 50.1	7 34.50	−0 28 17.8	+40.75	56 1.5	+3.9
13	12 15 53.8	.5110395	57 19 1.0	8 46.84	+5 5 5.6	− 1.18	59 59.6	−1.1
Nov. 2	11 24 1.3	.4750152	315 27 1.8	7 20.08	−0 45 14.3	+38.45	55 14.1	+4.0
2	12 46 54.4	.5325743	316 9 16.5	7 20.73	−0 41 32.5	+38.59	55 16.3	+4.0
3	12 12 43.7	.5088391	328 15 3.7	7 31.96	+0 22 27.2	+39.80	55 57.4	+3.9
1841, Feb. 7	7 2 50.5	.2936401	162 5 23.0	8 35.35	−2 9 35.1	−43.50	59 31.6	−0.2
27	6 38 5.5	.2764526	55 22 21.9	8 17.10	+5 12 30.8	− 5.90	58 24.5	+3.8
Apr. 28	8 23 35.2	.3497129	134 32 25.5	8 22.70	−0 1 57.2	−44.40	58 58.0	+2.1
May 23	8 49 32.4	.3677361	102 15 29.3	8 50.28	+2 28 12.8	−40.86	60 23.8	+2.0
June 4	14 14 16.7	.5932489	264 39 49.0	7 13.53	−3 38 56.0	+26.82	54 25.6	+3.4
30	10 51 47.2	.4526296	247 46 49.3	7 17.92	−4 34 51.2	+18.89	54 42.9	+3.9
July 28	16 51 1.1	.7020961	259 55 54.3	7 11.53	−4 0 20.5	+25.98	54 25.7	+4.0
Aug. 1	21 6 52.5	.8797743	309 24 26.2	7 5.79	+0 2 5.1	+39.46	54 3.0	+3.9
10	10 30 0.0	.4375000	56 32 14.5	8 13.81	+5 2 37.6	−13.61	58 15.5	+0.7
10	11 42 0.0	.4875000	57 13 25.0	8 14.50	+5 1 27.8	−14.21	58 18.0	+0.7
10	12 54 0.0	.5375000	57 54 39.0	8 15.13	+5 0 15.4	−14.70	58 20.5	+0.7
Sept. 6	16 0 0.0	.6666667	56 14 35.2	8 4.54	+4 56 47.6	−13.38	57 40.5	+0.2

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in 0d.01.	Geocentric Latitude of Moon.	Motion in 0d.01.	Parallax.	Jr.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1841, Sep. 6	17 12 0.0	.7166667	56 54 59.0	8 5.03	+4 55 39.4	−13.80	57 21.8	+0.2
6	18 24 0.0	.7666667	57 35 25.0	8 5.44	+4 54 28.8	−14.34	57 44.2	+0.2
22	6 49 31.0	.2843866	271 59 27.3	7 11.50	−5 0 24.9	+31.40	54 37.3	+3.9
25	12 0 18.8	.5002177	310 3 47.3	7 6.10	+0 12 32.9	+38.19	54 14.6	+4.7
Oct. 6	21 47 4.3	.9076888	97 45 12.6	8 23.31	+2 26 36.8	−39.05	58 56.9	−1.2
Nov. 27	14 1 14.5	.5841956	56 36 2.2	8 27.11	+4 36 28.1	−19.05	58 49.8	+1.7
27	14 44 35.7	.6143021	57 1 29.6	8 27.51	+4 35 30.0	−19.41	58 51.0	+1.7
1842, Jan. 17	14 21 22.5	.5981771	7 22 51.1	7 18.60	+4 53 59.5	+15.11	54 55.7	...
21	10 48 9.0	.4501042	56 41 29.6	8 8.40	+4 44 3.2	−20.22	57 57.9	+4.1
21	11 40 28.0	.4864352	57 11 5.4	8 9.00	+4 42 48.7	−20.59	58 0.0	+4.1
24	13 57 1.1	.5812628	101 21 44.0	8 56.40	+1 41 19.7	−47.09	60 44.9	+1.6
Mar. 22	8 18 36.1	.3462512	129 54 12.0	8 45.10	−1 4 8.9	−45.70	60 12.2	+3.0
22	8 26 52.2	.3519930	129 59 13.6	8 45.20	−1 4 35.2	−45.60	60 12.4	+3.0
Apr. 12	12 1 47.5	.5012442	46 55 9.4	7 46.05	+4 39 21.6	−14.89	56 23.4	+3.7
May 14	7 46 47.8	.3241644	108 25 15.3	8 21.50	+0 20 58.0	−44.70	58 49.1	+3.2
June 12	7 32 20.6	.3141273	132 50 48.4	8 36.90	−1 57 0.3	−43.80	59 40.7	+2.7
Oct. 7	18 35 6.2	.7743773	248 42 56.5	8 9.49	−3 3 50.0	+34.12	58 5.0	...
1843, Jan. 24	22 50 57.3	.9520521	245 21 6.3	8 0.61	−3 5 54.4	+35.55	57 32.	−1.1
Mar. 6	7 41 15.7	.3203206	46 19 46.0	7 13.50	+4 0 44.4	−23.20	54 37.1	+3.5
Apr. 2	12 16 2.9	.5111446	45 38 35.2	7 12.96	+3 51 16.8	−24.10	54 27.0	+3.8
May 3	6 33 8.0	.2730093	89 4 16.3	7 35.70	+0 22 32.1	−40.80	56 3.3	+3.5
3	9 5 1.2	.3784861	90 24 28.3	7 36.60	+0 15 21.0	−40.90	56 6.8	+3.5
3	9 19 38.5	.3886401	90 32 12.0	7 36.70	+0 14 39.5	−41.00	56 7.1	+3.5
9	9 14 46.4	.3852592	172 2 47.6	8 46.00	−5 2 49.1	− 9.00	60 3.0	+2.6
June 3	8 54 58.4	.3715092	140 5 32.5	8 12.90	−3 53 41.4	−30.30	58 13.6	+2.9
Sept. 11	12 44 17.9	.5307627	24 18 44.7	7 6.67	+4 30 40.0	−16.18	54 1.5	−0.1
30	13 51 17.4	.5772847	283 11 26.5	7 53.66	+1 25 17.8	+40.08	57 15.9	+2.8
Oct. 6	10 38 4.5	.4431077	356 16 8.0	7 12.40	+5 0 40.8	− 0.08	54 16.0	+2.1
Nov. 2	4 57 20.8	.2064908	350 27 28.5	7 12.60	+5 7 42.4	+ 2.50	54 25.5	+2.3
2	5 1 8.8	.2091297	350 29 22.7	7 12.60	+5 7 43.1	+ 2.50	54 25.4	+2.3
3	13 22 15.5	.5571239	6 36 3.8	7 8.40	+5 0 57.9	− 8.37	54 5.4	+2.4
27	8 6 49.7	.3380751	323 55 42.2	7 36.75	+4 35 51.4	+20.40	56 5.8	+1.8
1844, Jan. 8	9 43 32.7	.4052395	146 27 15.5	8 8.22	−4 41 10.7	−19.79	57 46.5	−1.2
8	10 57 54.3	.4568796	147 9 17.4	8 8.53	−4 42 51.5	−19.31	57 47.8	−1.2
Feb. 22	11 57 51.1	.4985081	26 29 1.4	7 10.27	+4 2 46.3	−22.55	54 22.2	+1.7
Apr. 26	9 39 20.3	.4023183	139 25 3.4	7 55.90	−4 42 35.9	−18.20	57 14.0	+2.4
May 23	14 35 0.0	.6076389	138 20 40.1	7 43.70	−4 46 32.3	−18.38	56 28.7	+2.3
Nov. 24	11 34 54.5	.4825753	62 47 58.0	7 5.27	+0 11 19.2	−39.43	54 0.1	+1.6
24	12 41 3.4	.5285116	63 20 31.3	7 5.18	+0 8 18.0	−39.42	53 59.9	+1.6
Dec. 14	14 12 52.2	.5922708	334 29 50.2	8 5.75	+5 16 27.8	+ 0.20	57 44.7	+2.1
1845, Jan. 12	4 58 25.0	.2072338	351 6 30.0	8 1.20	+4 54 20.1	−12.90	57 29.0	+2.1
12	5 3 0.4	.2104213	351 9 3.3	8 1.20	+4 54 15.9	−12.90	57 28.8	+2.1
Mar. 22	12 58 45.8	.5408079	172 7 52.0	8 4.88	−4 36 54.1	+18.15	57 30.4	+1.3
Apr. 12	9 20 41.3	.3893680	91 0 8.5	7 5.20	−2 59 54.3	−31.70	54 11.4	+1.8
May 16	7 28 58.1	.3117836	171 50 29.6	7 52.64	−4 45 16.8	+19.13	57 0.3	+2.5
16	8 20 20.9	.3474641	172 18 37.2	7 53.22	−4 44 7.8	+19.48	57 2.2	+2.5
20	8 23 56.8	.3499629	228 17 1.8	8 50.64	−0 41 0.4	+48.71	60 25.3	+1.5
20	8 29 53.7	.3540937	228 20 40.8	8 50.80	−0 40 40.3	+48.70	60 25.5	+1.5
June 16	11 35 1.1	.4826516	223 51 49.4	8 38.52	−1 2 59.7	+46.47	59 49.0	+2.0
July 16	14 18 31.6	.5961991	263 38 0.9	8 59.78	+2 31 33.2	+41.61	60 55.8	+1.7
17	14 56 0.1	.6222234	279 8 15.8	9 7.25	+3 36 46.2	+33.97	61 15.3	+1.2
Sept. 13	8 54 58.5	.3715104	323 17 46.6	8 44.20	+5 3 39.5	− 4.10	59 49.0	+2.3
22	16 10 52.3	.6742165	86 13 7.2	7 8.47	−3 12 52.5	−30.09	54 25.1	−1.8
22	21 8 16.7	.8807488	88 40 29.9	7 7.78	−3 23 3.7	−28.97	54 22.1	−1.8
Oct. 20	9 12 10.3	.3834525	90 34 24.8	7 10.18	−3 39 30.8	−28.37	54 26.8	−1.2
20	10 11 4.0	.4243518	91 3 43.9	7 10.02	−3 41 26.6	−28.13	54 26.2	−1.2
Nov. 6	6 57 48.5	.2901447	314 38 56.1	8 27.80	+5 17 10.1	+ 1.60	59 2.3	+2.5
6	6 58 43.6	.2907823	314 39 29.4	8 27.90	+5 17 10.2	+ 1.58	59 2.3	+2.5
6	7 33 53.5	.3152024	315 0 9.5	8 27.69	+5 17 13.7	+ 1.25	59 1.7	+2.5
9	9 20 3.9	.3889339	357 27 12.3	8 5.75	+4 0 12.1	−29.25	57 44.4	+2.6
9	9 27 18.1	.3939595	357 31 15.3	8 5.60	+3 59 57.5	−29.20	57 44.3	+2.6
9	10 29 29.5	.4371470	358 6 13.6	8 5.39	+3 57 50.0	−29.58	57 43.1	+2.6
10	10 27 36.6	.4358403	11 27 42.9	7 57.52	+3 2 50.3	−35.99	57 15.0	+2.4
Dec. 6	15 16 0.4	.6361158	357 44 6.5	8 3.81	+3 55 38.4	−29.15	57 44.5	+2.2
1846, Feb. 6	13 52 31.4	.5781313	91 9 44.5	7 8.29	−3 49 29.3	−24.18	54 13.5	+0.9
20	22 4 58.8	.9201251	271 11 52.6	8 38.20	+3 57 26.5	+28.40	59 42.6	+0.1
Mar. 31	15 27 39.9	.6442118	72 8 36.3	7 31.55	−2 59 19.0	−33.88	55 49.0	+1.6
May 3	13 38 33.9	.5684479	139 27 18.9	7 8.38	−5 9 44.6	+ 8.31	54 16.5	+2.0
4	10 0 12.2	.4168079	149 34 32.1	7 10.90	−4 53 10.0	+15.00	54 26.4	+2.0
June 29	13 11 29.0	.5496412	167 19 24.7	7 9.50	−3 45 12.9	+25.59	54 24.6	+1.3

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in 0d.01.	Geocentric Latitude of Moon.	Motion in 0d.01.	Parallax.	Δv.
	h m s	d	° ' "	' "	° ' "	"	' "	"
1846, July 5	9 18 34.8	.3879028	241 32 20.2	8 19.88	+2 16 43.4	+39.42	58 41.1	+1.2
Aug. 14	13 6 9.1	.5459387	64 44 59.7	7 35.22	−2 49 32.1	−33.40	56 5.2	−1.5
14	13 59 23.2	.5829075	65 13 1.9	7 34.80	−2 51 35.3	−33.15	56 3.6	−1.5
Sept. 14	12 2 51.7	.5019874	110 2 52.4	7 11.75	−5 7 16.9	− 5.85	54 26.1	−1.3
Nov. 22	4 44 11.9	.1973599	287 31 5.7	8 25.58	+5 7 2.8	+ 7.99	58 47.7	+1.5
1847, Apr. 25	7 50 50.1	.3269688	162 51 15.6	7 4.94	−3 6 15.3	+31.75	54 5.5	0.0
May 21	7 35 48.8	.3165371	147 8 30.0	7 11.62	−4 1 22.9	+24.64	54 34.0	...
June 17	7 2 40.3	.2935221	142 42 36.4	7 18.98	−4 3 41.1	+23.13	54 55.8	−0.9
Oct. 18	8 51 46.1	.3692836	314 26 42.5	8 22.02	+4 20 52.7	−26.25	58 47.6	+2.0
1848, Feb. 15	6 46 58.2	.2826180	106 9 56.5	7 56.50	−5 0 45.4	+11.20	57 3.9	+1.2
Mar. 28	16 12 6.6	.6750764	291 53 42.8	7 50.02	+4 55 59.6	−15.72	56 52.2	−0.4
Apr. 15	9 0 12.9	.3751493	176 19 1.4	7 9.48	−0 23 16.2	+39.36	54 20.9	+0.2
May 8	5 11 25.5	.2162674	121 17 4.0	7 58.35	−4 22 33.3	+22.62	57 24.1	+1.3
9	9 9 48.2	.3818079	136 28 21.6	7 40.30	−3 30 41.4	+30.20	56 23.0	+1.2
17	9 2 49.1	.3769572	232 35 24.8	7 9.86	+4 5 20.5	+22.60	54 9.7	−0.9
17	10 35 4.0	.4410186	233 21 19.4	7 10.09	+4 7 43.8	+22.17	54 10.4	...
June 8	9 24 15.6	.3918473	170 3 11.1	7 17.76	−0 36 29.7	+38.45	55 4.9	+0.6
Nov. 8	8 27 51.6	.3526806	15 18 27.7	8 53.10	−2 10 48.6	−42.97	60 34.5	+1.0
Dec. 4	6 3 18.7	.2522998	354 10 2.4	8 11.00	−0 36 17.7	−42.90	58 19.0	+2.8
1849, Jan. 3	4 56 39.2	.2060092	31 16 43.5	8 31.80	−3 43 36.2	−30.80	59 22.9	+3.1
3	6 2 53.4	.2520069	31 55 59.1	8 32.40	−3 45 57.6	−30.50	59 24.6	...
Feb. 13	11 26 45.1	.4769109	222 12 49.8	7 11.31	+4 33 36.1	+19.81	54 30.5	−2.3
13	12 38 58.6	.5270672	222 48 52.7	7 11.06	+4 35 14.5	+19.41	54 29.6	...
Apr. 5	7 4 30.3	.2947952	174 11 31.8	7 40.30	+1 6 17.5	+40.90	56 13.0	+0.8
6	8 39 25.5	.3607119	187 42 51.9	7 33.11	+2 15 46.6	+36.96	55 42.6	0.0
6	10 6 43.2	.4213334	188 28 37.6	7 32.77	+2 19 29.9	+36.65	55 40.9	...
July 13	12 54 24.8	.5377871	30 53 35.3	8 20.73	+4 20 23.5	−24.48	58 42.7	−1.1
13	13 23 56.1	.5582883	31 10 42.3	8 21.00	−4 21 13.6	−24.32	58 43.6	...
Sept. 25	8 23 49.2	.3498751	287 37 56.7	7 9.93	+3 42 15.8	−27.67	54 27.9	+0.2
25	9 24 18.4	.3918797	288 8 3.0	7 10.05	+3 40 19.0	−27.89	54 28.6	...
Oct. 3	7 57 35.7	.3316633	31 16 23.4	8 30.00	4 25 11.7	23.74	59 1.6	−0.4
25	5 54 42.1	.2463206	318 20 59.2	7 21.70	+1 7 33.5	−38.40	55 18.5	+0.5
Nov. 23	7 11 49.6	.2998797	339 25 23.0	7 31.01	−0 59 38.5	−39.01	55 54.7	+1.3
23	8 28 26.2	.3530810	340 5 24.3	7 31.66	−1 3 6.1	−38.98	55 57.2	...
26	11 2 34.2	.4601180	21 11 24.7	8 23.50	−4 1 50.2	−26.29	58 47.8	+1.3
Dec. 1	9 12 13.4	.3834885	94 19 18.3	9 4.88	−4 0 7.4	+28.88	61 5.8	−0.2
22	3 11 14.5	.1328068	358 32 34.9	7 39.38	−2 49 15.7	−34.38	56 22.4	...
1850, Jan. 17	7 55 1.0	.3298728	345 20 0.0	7 23.10	−1 55 36.7	−37.82	55 15.6	+1.9
23	8 13 39.2	.3428149	65 3 27.3	8 39.72	−5 9 41.2	+ 9.21	59 42.4	+3.7
25	7 37 24.6	.3176459	94 13 59.3	9 1.75	−4 0 43.9	+32.23	60 57.2	+3.0
25	8 54 30.4	.3711852	95 2 20.4	9 2.12	−3 57 50.0	+32.75	60 58.5	
Feb. 21	7 25 41.1	.3095035	88 44 20.8	8 38.84	−4 20 18.5	+27.42	59 43.8	+4.4
21	7 41 25.2	.3204306	88 53 48.0	8 38.98	−4 19 48.5	+27.59	59 44.1	...
Apr. 15	5 51 38.0	.2441898	66 50 27.0	8 29.30	−4 53 3.4	+11.80	59 0.2	+2.2
15	8 5 59.0	.3374884	63 9 39.7	8 29.60	−4 51 7.9	+12.90	59 1.6	...
16	7 43 34.9	.3219317	82 7 24.3	8 31.20	−4 21 29.9	+23.00	59 13.0	+2.7
17	5 19 40.4	.2219954	94 54 26.8	8 31.15	−3 40 38.3	+31.14	59 18.0	+3.1
21	10 40 16.4	.4446342	154 20 58.1	8 20.70	+1 9 1.9	+43.20	58 45.7	+3.4
22	6 46 36.0	.2823611	165 57 44.9	8 17.30	+2 7 15.2	+39.90	58 29.7	+3.2
June 13	6 8 57.7	.2562234	130 21 12.1	8 47.02	−0 30 19.2	+47.06	60 18.7	+3.2
13	6 10 2.2	.2569711	130 21 51.5	8 47.05	−0 30 15.7	+47.06	60 18.6	...
July 30	12 18 9.5	.5126100	22 53 10.9	7 39.07	−4 55 7.8	−15.70	56 11.2	−1.6
Aug. 14	8 49 44.5	.3678762	233 7 50.5	7 37.10	+5 14 19.3	− 6.10	56 3.8	+1.1
31	15 2 50.7	.6269758	88 5 8.2	8 29.60	−3 48 50.2	+32.19	59 15.3	−0.3
Sept. 1	15 19 0.1	.6381969	102 33 52.7	8 41.02	2 47 17.4	+40.52	59 56.3	+0.5
30	14 15 22.0	.5940048	126 18 19.4	8 37.39	−0 37 49.0	+46.03	59 46.7	0.0
Nov. 17	7 11 16.3	.2994944	31 20 59.6	7 57.56	−4 59 23.2	5.28	57 4.5	−0.2
1851, Jan. 15	5 46 15.0	.2404514	87 59 58.8	8 44.10	−3 13 52.7	+38.30	59 59.3	+1.3
Mar. 9	8 27 57.6	.3527500	65 48 37.9	7 50.56	−4 24 55.6	+21.97	56 55.1	+3.0
13	9 43 5.2	.4049213	121 41 20.6	8 43.80	−0 15 27.9	+47.20	60 9.0	+3.8
26	16 18 2.1	.6791910	304 51 46.9	7 5.52	−0 6 15.7	−37.98	54 15.1	−2.0
Apr. 18	13 42 25.8	.5711320	249 23 32.4	8 3.01	+3 56 39.8	−26.22	57 34.3	−0.2
May 17	15 20 30.7	.6392443	271 23 19.6	7 43.59	+2 17 47.5	−36.75	56 27.2	−0.4
17	16 14 25.9	.6766888	271 52 14.9	7 43.10	+2 15 29.7	−36.86	56 25.6	...
18	8 12 22.7	.3419296	280 21 5.4	7 34.71	+1 33 36.3	−38.54	55 58.3	−0.6
18	8 28 34.5	.3531773	280 29 36.9	7 34.66	+1 32 53.0	−38.56	55 57.9	...
18	9 2 59.1	.3770731	280 47 43.0	7 34.31	+1 31 20.8	−38.60	55 57.0	...
June 7	10 39 2.1	.4437745	182 1 23.6	8 28.68	+4 40 55.9	+19.42	59 6.0	+3.0
17	13 29 28.8	.5621402	315 35 12.6	7 12.54	−1 41 52.7	−37.41	54 36.5	−1.7
July 12	5 35 45.6	.2331668	283 10 14.7	7 30.23	+1 12 52.3	−40.50	55 34.2	−0.3

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in $0^d.01$.	Geocentric Latitude of Moon.	Motion in $0.^d01$.	Parallax.	Δε.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1851, Aug. 2	8 13 59.8	.3430533	202 2 27.9	8 31.50	+5 15 29.8	+ 3.50	59 14.8	+2.9
8	7 24 45.2	.3088566	280 54 55.0	7 26.58	+1 24 49.8	−39.62	55 25.5	+0.6
8	8 51 19.9	.3689804	281 39 38.7	7 26.24	+1 20 51.3	−39.71	55 23.8	...
Sept. 4	8 59 21.8	.3745579	278 48 44.0	7 27.20	+1 29 45.6	−38.60	55 35.8	+0.8
Oct. 17	18 33 26.9	.7732280	117 37 43.8	8 11.49	+0 32 13.0	+43.08	58 20.3	...
Dec. 5	6 53 30.1	.2871540	39 37 33.0	7 25.90	−4 48 29.1	+15.00	55 12.0	−1.6
7	8 41 28.3	.3621331	65 50 55.6	7 44.17	−3 27 23.1	+31.45	56 19.7	−1.2
7	9 51 7.6	.4105046	66 28 21.7	7 44.56	−3 24 50.3	+31.75	56 21.4	...
31	7 24 32.9	.3087141	23 18 43.3	7 12.09	−5 15 10.8	+ 4.20	54 30.0	−1.4
1852, Jan. 4	3 23 28.1	.1412978	71 0 28.2	7 48.40	−3 7 42.8	+34.80	56 42.0	−0.7
6	5 45 44.8	.2401019	99 3 16.2	8 13.40	−0 45 12.1	+45.20	58 11.9	−0.4
Feb. 15	14 44 33.1	.6142731	281 52 48.3	7 39.58	+0 26 22.2	−41.54	56 16.8	−1.7
15	15 37 41.2	.6511712	282 21 3.7	7 39.31	+0 23 49.0	−41.52	56 15.6	...
Mar. 9	11 32 35.5	.4809663	222 23 40.9	8 44.72	+4 29 24.9	−21.43	60 1.5	−0.8
9	12 27 30.2	.5190995	222 57 0.7	8 44.11	+4 28 2.6	−21.75	59 59.7	...
30	8 44 53.1	.3645035	124 57 5.6	8 16.40	+1 53 40.3	+40.40	58 34.8	+3.0
30	9 19 3.5	.3882350	125 16 44.0	8 16.70	+1 55 16.2	+40.30	58 56.2	...
30	9 19 22.4	.3884537	125 16 54.8	8 16.70	+1 55 17.1	+40.30	58 36.2	...
30	9 40 15.2	.4029537	125 28 55.4	8 17.10	+1 56 15.5	+40.30	58 37.0	...
Apr. 25	6 42 30.7	.2795220	106 43 3.8	7 44.20	+0 35 42.4	+41.00	56 40.2	+2.1
27	9 30 42.9	.3963298	134 47 48.2	8 12.20	+2 54 22.1	+35.80	58 18.9	+3.2
28	10 21 3.0	.4312847	149 10 34.7	8 28.10	+3 51 4.9	+29.30	59 9.9	+3.5
Aug. 25	6 47 43.6	.2831435	287 8 49.0	7 53.90	−0 56 5.4	−41.60	57 8.2	+1.7
Sept. 18	6 2 33.6	.2517777	242 36 49.7	8 33.20	+2 38 3.9	−38.40	59 31.1	+2.5
Sept. 23	7 46 19.0	.3238310	310 31 39.7	7 36.40	−2 59 37.8	−32.10	56 2.1	+0.9
Oct. 23	6 27 1.2	.2687639	344 10 2.4	7 17.86	−4 51 16.7	−11.07	54 45.4	+0.1
24	5 24 19.6	.2252268	355 44 27.2	7 13.50	−5 2 47.3	− 3.40	54 24.9	−0.5
1853, Jan. 6	19 29 51.6	.8124028	255 40 10.6	8 41.73	+1 11 36.7	−46.86	59 54.7	...
6	20 48 35.2	.8670741	256 27 42.7	8 41.57	+1 7 20.2	−46.99	59 54.3	...
Feb. 18	5 22 39.3	.2240660	88 28 1.9	7 20.40	+0 9 17.7	+39.20	55 11.5	+0.4
Apr. 20	6 51 35.8	.2858310	171 8 23.6	8 35.07	+5 7 22.3	− 0.25	59 22.2	+2.3
May 12	7 34 39.4	.3157338	102 28 4.2	7 13.30	+2 1 58.3	−36.60	54 39.5	+0.4
20	9 0 31.5	.3753646	210 11 56.8	8 58.70	+3 59 55.2	−32.00	60 47.5	+2.8
July 17	9 24 38.3	.3921100	258 16 12.2	8 48.90	+0 5 0.1	−48.20	60 22.2	+3.1
Sept. 6	5 54 15.9	.2460173	206 10 23.7	8 29.05	+3 46 54.8	−29.38	59 4.8	+2.6
8	6 45 12.4	.2813935	235 0 58.8	8 30.09	+1 42 41.1	−42.26	59 20.2	+3.4
11	8 38 14.4	.3598889	278 25 14.1	8 24.25	−2 1 23.0	−40.71	58 59.3	+3.2
Nov. 7	8 54 36.5	.3712558	313 40 14.9	8 12.17	−4 40 28.4	−20.54	58 12.1	+1.8
Dec. 8	8 44 56.4	.3645417	2 52 36.9	7 35.79	−4 54 13.2	+15.99	55 59.9	−0.2
1854, Jan. 7	6 19 49.3	.2637651	35 22 5.5	7 15.80	−2 58 2.1	+32.60	54 52.8	−1.1
Mar. 3	5 58 17.9	.2488183	39 4 32.1	7 29.10	−2 12 8.2	+35.60	55 40.0	−1.3
7	7 4 41.3	.2949225	87 41 44.8	7 4.67	+1 57 55.4	+34.59	54 13.3	−0.7
20	11 18 35.1	.4712396	259 48 36.8	8 27.25	−1 26 22.5	−43.29	59 12.4	−0.5
22	12 19 8.2	.5132894	288 39 6.1	8 29.07	−3 37 1.5	−31.76	59 12.2	−0.7
22	13 14 53.5	.5520081	289 11 57.5	8 29.12	−3 39 3.9	−31.46	59 12.0	...
Apr. 13	9 21 55.2	.3902222	212 1 40.4	8 29.47	+2 34 20.9	−40.02	59 5.8	+0.5
13	10 28 28.6	.4364421	212 40 56.0	8 29.83	+2 31 15.3	−40.31	59 7.2	...
15	10 40 7.8	.4445347	241 24 56.8	8 38.45	+0 1 31.6	−47.14	59 44.6	−0.1
May 11	5 4 23.0	.2113773	217 54 4.9	8 38.02	+2 6 11.5	−43.95	59 39.2	+1.3
11	12 44 12.0	.5306944	222 30 42.6	8 41.44	+1 42 23.1	−45.59	59 51.5	...
22	17 9 2.7	.7146157	20 8 6.2	7 37.54	−3 29 27.7	+31.81	56 2.9	−2.8
June 7	5 27 4.6	.2271365	212 1 28.3	8 25.32	+2 35 5.7	−40.60	59 0.4	+2.4
7	6 23 25.5	.2662073	212 34 26.7	8 25.87	+2 32 26.3	−40.82	59 2.6	...
14	9 38 13.6	.4015462	318 26 31.9	8 42.23	−5 7 8.2	−10.47	59 50.7	−2.0
14	10 32 32.3	.4392626	318 59 20.9	8 41.83	−5 7 46.9	−10.00	58 48.9	...
July 5	8 44 59.2	.3645741	222 31 53.5	8 22.32	+1 36 12.8	−43.19	58 55.5	+2.9
7	9 44 39.0	.4060069	251 55 6.4	8 53.10	−1 1 3.9	−47.10	60 37.2	+2.3
13	13 26 33.8	.5601135	344 8 52.7	8 31.25	−4 58 2.0	+11.14	59 13.2	−2.3
13	14 35 0.3	.6076425	344 49 20.8	8 30.44	−4 57 7.9	+11.67	59 10.6	...
20	5 17 13.1	.2202606	177 37 45.8	7 31.30	+4 25 7.1	−19.22	55 38.5	+1.6
July 31	8 11 47.9	.3415266	204 45 24.6	7 50.80	+2 48 50.3	−34.60	57 1.0	+3.1
Aug. 8	5 43 36.1	.2386124	318 23 33.6	9 2.79	−4 56 50.5	− 7.85	60 52.5	+0.2
8	6 43 3.6	.2799029	319 0 54.6	9 2.52	−4 57 21.9	− 7.34	60 51.6	...
14	13 2 56.9	.5437142	45 44 54.6	7 29.43	−1 0 53.2	+38.87	55 48.4	...
14	14 12 44.1	.5921772	46 21 11.5	7 28.83	−0 57 44.8	+38.91	55 46.3	...
Sept. 1	9 10 10.0	.3820603	270 22 55.2	8 35.34	−2 53 5.4	−37.26	59 36.8	+3.1
2	8 34 38.4	.3573890	284 28 21.2	8 44.50	−3 48 15.3	−30.15	60 2.6	+2.7
2	10 17 6.6	.4285487	285 30 35.7	8 45.06	−3 51 48.1	−29.61	60 4.2	...
30	6 46 0.7	.2819525	293 51 54.3	8 34.20	−4 29 12.4	−22.50	59 26.4	+2.9
30	8 22 44.3	.3491239	294 49 29.4	8 34.50	−4 31 41.7	−21.80	59 27.0	...

Date.	Greenwich Mean Time.		Geocentric Longitude of Moon.	Motion in $0^d.01$.	Geocentric Latitude of Moon.	Motion in $0^d.01$.	Parallax.	Δv.
	h m s	d	° ′ ″	′ ″	° ′ ″	″	′ ″	″
1854, Oct. 29	7 47 20.7	.3245452	319 38 15.9	8 28.07	−5 15 22.6	− 2.20	59 1.6	+2.0
Nov. 27	8 15 29.5	.3440915	344 45 39.2	8 16.71	−4 52 18.2	+17.49	58 25.5	+0.9
27	9 21 29.1	.3899202	345 23 34.7	8 16.28	−4 50 57.0	+17.95	58 24.1	...
1855, Jan. 3	10 30 7.2	.4375845	109 30 49.9	7 8.88	+4 20 29.7	+19.83	54 4.5	−2.8
Apr. 4	11 28 30.8	.4781343	222 40 55.1	7 49.39	+0 1 35.5	−42.87	56 47.9	−1.1
4	12 40 18.0	.5279862	223 19 55.8	7 49.72	−0 1 58.3	−42.90	56 49.4	...
4	12 50 56.7	.5353797	223 25 43.2	7 49.81	−0 2 30.0	−42.91	56 49.6	...
8	12 39 21.4	.5273311	277 13 52.9	8 21.00	−4 15 6.1	−26.70	58 42.4	−1.3
8	13 41 13.0	.5702894	277 49 45.7	8 21.30	−4 17 0.1	−26.35	58 43.5	...
May 8	14 0 34.5	.5837326	317 17 55.9	8 32.57	−5 15 43.5	+ 3.65	59 17.7	−2.3
1856, Apr. 25	14 9 24.7	.5898692	282 17 44.4	5 57.55	−5 9 41.1	− 9.11	57 13.9	−1.8
25	15 39 35.3	.6524919	283 7 37.1	7 58.22	−5 10 36.5	− 8.50	57 16.3	...
Sept. 8	7 54 27.4	.3294838	270 0 50.7	7 47.25	−5 2 14.5	−11.55	56 41.4	+1.1
Nov. 12	7 42 45.3	.3213576	56 56 22.1	8 57.67	+3 28 20.2	+36.24	60 42.1	...
12	8 47 26.3	.3662766	57 36 36.6	8 57.30	+3 31 2.0	+35.79	60 40.9	...
1857, Jan. 15	12 44 58.8	.5312361	182 24 11.0	7 11.03	+0 35 16.4	−37.94	54 37.1	−4.0
15	13 37 57.2	.5680231	182 50 36.3	7 10.89	+0 32 56.8	−37.96	54 36.3	...
Feb. 6	11 3 0.1	.4604178	113 29 57.0	8 1.73	+4 54 39.1	−11.88	57 18.7	−2.3
Mar 16	11 3 51.2	.4610092	244 57 29.5	7 10.49	−4 31 28.7	−20.57	54 26.0	−1.4
16	12 3 30.7	.5024386	245 27 13.2	7 10.68	−4 32 53.2	−20.32	54 26.8	...
16	16 44 14.6	.4482303	247 47 20.4	7 11.73	−4 39 15.5	−18.94	54 30.9	...
18	10 34 59.5	.4409664	269 1 18.0	7 26.42	−5 14 55.7	− 5.14	55 24.6	−1.0
18	10 45 27.1	.6973912	269 6 42.3	7 26.51	−5 14 59.4	− 5.08	55 24.9	...
19	11 42 34.9	.4879039	282 10 48.1	7 38.96	−5 15 44.8	+ 4.34	56 10.3	−0.9
31	8 7 39.1	.3386470	91 50 42.6	8 17.12	+5 16 37.4	+ 3.44	58 26.3	−1.7
Apr. 29	5 17 0.0	.2201389	113 23 39.2	8 8.43	+4 58 0.2	−13.47	57 57.3	−1.7
May 31	10 14 0.6	.4263958	175 52 51.6	7 14.90	+0 42 58.1	−38.34	54 53.1	−0.7
July 27	6 11 58.6	.2583171	202 14 38.1	7 10.83	−2 3 38.3	−35.36	54 36.0	−0.8
Nov. 23	5 48 5.4	.2417291	319 45 53.2	7 35.65	−2 53 11.8	+33.11	56 7.2	+2.3
23	6 57 31.1	.2899432	320 22 31.1	7 36.17	−2 50 31.4	+33.40	56 9.3	...
1858, Mar. 6	9 54 31.3	.4128622	246 52 36.7	7 8.04	−5 11 15.8	− 7.45	54 15.3	−0.8
6	10 48 45.0	.4505208	247 19 28.5	7 8.00	−5 11 43.1	− 7.10	54 15.1	...
Oct. 12	8 58 12.9	.3737604	265 48 24.7	7 9.05	−4 54 25.5	+11.93	54 17.8	0.0

Since the right ascension and declination of the moon, based on Hansen's tables, are available from 1847 on, the direct computation from Hansen is unnecessary after that date, α and δ being interpolated from the Nautical Almanac. The reduction to the provisional theory for all dates not already given is found in the table following, which is a continuation of the last column of the preceding table. In cases where several occultations have been observed on the same day, Δv was generally computed for the mean of the times.

Date.	Δv.	Date.	Δv.	Date.	Δv.	Date.	Δv.
	″		″		″		″
1847, Jan. 3	−0.6	1848, June 6	+0.5	1849, Sept. 8	−0.2	1850, Oct. 14	−0.7
5	−1.1	13	−0.2	27	+0.4	21	−0.8
25	+1.2	July 11	+1.2	Nov. 22	+1.1	Nov. 21	−0.5
Feb. 24	+0.6	15	−0.9	29	+0.1	Dec. 7	+0.4
Mar. 24	+0.8	Aug. 7	−0.7	1850, Feb. 26	+1.8	1851, Apr. 6	+2.4
26	+0.1	21	−2.7	Mar. 23	+3.6	7	+2.0
Apr. 22	+0.6	Sept. 15	−2.0	24	+3.5	July 21	−2.0
May 23	−0.2	Oct. 28	−1.3	Apr. 18	+3.3	Sept. 14	−2.7
28	−0.5	Nov. 9	+0.5	May 19	+3.1	Oct. 2	+0.1
June 1	−1.3	1849, Feb. 9	−0.7	28	−2.1	11	−2.1
Sept. 16	+0.4	27	+2.2	June 1	−2.2	28	−0.1
Nov. 18	+1.6	Mar. 2	+2.9	14	+3.4	Dec. 10	−1.2
1848, Jan. 12	+2.1	3	+2.8	July 21	−0.8	1852, Feb. 3	+0.7
16	+2.2	8	+0.2	24	−2.2	11	−1.2
Feb. 12	+1.6	11	−1.1	Aug. 2	−0.5	May 2	+2.1
Mar. 11	+1.4	29	+2.4	8	+1.8	July 4	−2.1
21	−1.5	May 2	+1.0	27	−1.4	Aug. 26	+0.6
Apr. 12	+0.8	July 12	−2.3	30	−0.9	1853, Jan. 14	−0.8
May 4	+0.8	16	+1.5	Sept. 12	−0.3	Feb. 17	+0.4
7	+1.2	Sept. 5	−1.2	Oct. 13	−0.7	Mar. 26	+0.5

Date.	*Δv.*	Date.	*Δv.*	Date.	*Δv.*	Date.	*Δv.*
	″		″		″		″
1853, Mar. 28	−0.1	1859, Nov. 11	−4.4	1863, May 4	−6.8	1866, Aug. 29	−9.3
May 22	+2.0	Dec. 8	−1.1	June 28	−4.3	Sept. 15	−4.1
Aug. 29	−2.2	21	−2.8	30	−5.0	28	−9.4
Sept. 20	−3.0	1860, Jan. 4	−1.1	July 28	−4.4	29	−9.1
Oct. 14	+0.3	6	−3.1	Aug. 7	−4.7	Nov. 16	−4.1
Dec. 9	−0.1	Feb. 13	−5.1	27	−6.6	20	−5.1
1854, Feb. 7	−1.1	28	−0.1	30	−4.6	27	−8.4
9	−0.9	Mar. 1	−0.7	Sept. 24	−3.6	Dec. 24	−7.4
Mar. 12	+0.2	4	−2.1	Oct. 22	−3.1	1867, Jan. 29	−7.0
Apr. 4	−0.4	5	−2.8	23	−2.6	Apr. 8	−4.6
May 6	+1.4	7	−3.7	30	−4.1	16	−5.2
9	+2.0	12	−3.9	Nov. 3	−5.4	18	−6.0
June 28	−0.1	28	−1.1	17	−3.3	May 5	−5.3
Sept. 4	+1.6	Apr. 27	−2.2	19	−2.5	June 14	−5.5
19	−0.8	May 1	−2.7	30	−4.5	July 9	−5.5
Oct. 11	−3.3	8	−2.3	Dec. 19	−2.1	Oct. 16	−8.3
Dec. 10	−1.9	25	−2.5	24	−1.5	Nov. 6	−5.3
1855, Mar. 23	−2.2	June 1	−2.4	27	−3.7	8	−5.5
Apr. 7	−1.2	3	−2.3	30	−5.5	Dec. 28	−6.1
23	−1.9	Aug. 24	−0.7	1864, Jan. 24	−2.9	1868, Feb 8	−6.3
June 27	+0.8	30	+0.9	Feb. 13	−2.7	11	−8.2
Aug. 30	−3.4	Sept. 6	−2.8	14	−2.5	28	−4.4
Sept. 20	+2.3	Oct. 17	−3.1	16	−2.1	29	−3.8
21	+2.0	Nov. 5	−5.4	25	−6.3	Mar. 1	−3.0
Oct. 24	+1.0	Dec. 19	+1.3	29	−7.3	28	−4.1
Nov. 15	+2.2	1861, Mar. 19	+0.4	Mar. 18	−2.8	Apr 4	−5.5
1856, Jan. 12	−0.2	Apr. 19	−1.7	19	−3.2	May 4	−5.7
Mar. 11	−1.4	27	−3.6	24	−6.4	22	−5.5
13	−1.7	May 19	−2.7	27	−8.0	27	−4.4
26	−1.5	June 11	−2.4	Apr. 11	−2.3	June 24	−5.5
June 16	−0.3	25	−1.8	20	−5.5	July 1	−5.8
July 25	−4.7	Sept. 14	0.0	23	−8.1	Aug. 9	−7.0
Sept. 20	−5.9	26	−4.1	27	−8.3	Sept. 4	−6.6
Nov. 11	−1.7	Oct. 15	+0.6	May 20	−6.3	6	−7.0
1857, Mar. 4	−1.8	19	−0.6	June 20	−7.6	7	−7.4
Apr. 2	−1.7	20	−1.2	26	−7.4	8	−7.4
May 6	0.0	22	−2.6	July 18	−6.5	9	−7.2
27	+0.7	Dec. 23	−5.5	23	−7.3	28	−5.9
Sept. 29	−1.0	1862, Feb. 4	+0.8	Aug. 12	−4.9	1869, Jan. 23	−3.1
30	−0.3	Mar. 9	0.0	Nov. 4	−4.4	24	−3.7
Oct. 6	−5.0	15	−4.5	5	−4.1	28	−6.5
26	+1.6	Apr. 15	−5.6	10	−2.6	Feb. 15	−4.2
28	+0.8	May 8	−2.1	19	−6.8	19	−2.7
Nov. 27	−0.2	11	−3.7	Dec. 5	−3.7	Mar. 23	−3.4
Dec. 26	−0.2	June 9	−0.7	6	−3.6	Apr. 16	−3.5
1858, Feb. 19	−0.5	July 15	−2.8	1865, Jan 8	−3.4	May 18	−3.6
20	−0.2	21	−1.3	12	−5.0	Aug. 2	−9.1
Apr. 25	−1.9	Aug. 1	−3.3	Feb. 2	−3.3	13	−6.3
May 18	−1.9	Sept. 3	−2.5	9	−4.8	19	−6.1
19	−1.7	Oct. 11	−2.5	Mar. 3	−3.5	29	−7.0
20	−1.7	29	−2.0	15	−6.5	Nov. 10	−6.9
Aug. 30	−6.0	Dec. 7	−2.2	Apr. 30	−3.9	17	−6.0
Sept. 18	−0.1	10	−4.5	July 3	−4.8	Dec. 8	−6.5
21	−1.2	13	−5.9	8	−6.2	14	−5.3
Oct. 14	+0.7	1863, Jan. 9	−6.4	Aug. 6	−6.5	1870, Jan. 5	−5.9
21	−2.4	27	−1.4	Sept. 11	−6.9	Feb. 7	−3.4
Nov. 22	−5.8	Feb. 23	−1.4	29	−4.1	9	−2.9
Dec. 22	−5.8	Mar. 2	−3.8	Oct. 4	−6.3	10	−2.9
1859, Jan. 21	−4.9	12	−7.1	Nov. 4	−6.0	11	−3.1
Feb. 8	+0.6	22	−1.5	5	−6.5	12	−2.5
11	0.0	24	−0.6	Dec. 30	−4.2	22	−9.3
16	−2.9	Apr. 2	−5.1	1866, Jan. 8	−6.4	Mar. 10	−2.8
Apr. 11	−2.3	7	−6.8	Feb. 27	−5.6	23	−9.1
13	−2.4	8	−7.6	Apr. 20	−5.0	June 16	−8.2
May 5	−2.2	9	−7.4	May 11	−7.6	July 10	−6.3
7	−2.6	21	−1.6	20	−4.7	Aug. 9	−6.5
Aug. 18	−2.7	25	−2.0	June 18	−4.5	17	−7.2
Sept. 21	−6.0	26	−2.1	July 8	−8.2	19	−6.6
Oct. 28	−1.7	29	−4.0	26	−5.7	Sept. 6	−6.7
Nov. 8	−1.5	30	−4.6	31	−8.9	7	−6.1

Date.	Δv.	Date.	Δv.	Date.	Δv.	Date.	Δv.
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1870, Sept. 16	− 6.7	1874, Mar. 31	− 7.5	1877, Sept. 25	− 9.2	1880, May 18	−10.0
28	− 6.2	Apr. 22	−11.0	Nov. 20	− 8.3	26	−14.6
Oct. 1	− 6.2	May 19	− 8.9	22	− 8.7	June 13	− 9.0
14	− 9.9	July 8	−11.4	1878, Jan. 10	− 4.8	14	− 9.3
Nov. 9	− 7.8	Aug. 20	− 5.4	Feb. 15	− 9.4	18	−11.9
Dec. 27	− 7.1	31	− 6.3	Mar. 7	− 4.8	20	−12.9
1871, Jan. 11	− 7.5	Oct. 22	− 7.4	16	− 9.9	21	−13.6
Feb. 1	− 5.5	25	− 8.3	Apr. 9	− 6.6	25	−13.7
28	− 4.7	Nov. 19	− 7.0	13	− 9.3	30	−11.1
Mar. 3	− 4.8	Dec. 16	− 8.4	May 26	− 6.3	July 17	−11.7
May 5	− 6.8	19	− 7.2	June 5	− 8.8	19	−12.4
June 29	− 5.8	1875, Jan. 16	− 7.3	14	−10.0	20	−12.6
Sept. 7	− 8.4	20	− 9.1	27	− 7.2	27	−11.9
22	− 5.6	30	− 7.4	Aug. 6	−10.2	30	−10.5
27	− 7.8	Feb. 13	− 7.8	Sept. 5	− 9.2	Aug. 16	−11.4
Oct. 3	− 8.5	Mar. 16	− 8.9	6	− 8.8	28	−10.7
21	− 6.3	May 12	− 9.0	17	− 8.6	Sept. 11	−11.4
23	− 6.6	Aug. 10	− 6.0	Oct. 5	− 8.2	12	−11.0
27	− 7.2	13	− 5.7	Nov. 10	− 8.2	13	−11.1
Nov. 15	− 6.7	Sept. 10	− 5.9	13	−10.4	14	−10.8
18	− 7.4	12	− 6.1	Dec. 2	− 6.5	17	−10.0
27	− 6.9	14	− 7.7	7	− 7.3	25	−10.7
Dec. 1	− 7.1	Oct. 3	− 7.3	1879, Jan. 6	− 8.6	Oct. 7	−12.5
18	− 8.1	16	−11.0	Feb. 3	− 8.1	10	−11.6
20	− 7.5	20	−13.0	26	− 6.0	15	−10.0
1872, Jan. 23	− 5.6	24	−12.2	28	− 6.1	Nov. 17	− 9.8
Feb. 21	− 5.8	Nov. 8	− 6.2	Apr. 1	− 8.2	19	−10.3
Apr. 25	− 8.8	16	−12.7	14	−12.3	20	−10.6
May 19	− 4.6	21	−12.4	25	− 6.8	Dec. 12	−11.3
22	− 6.8	Dec. 7	− 5.8	26	− 7.4	1881, Jan. 5	−11.9
July 22	− 9.7	9	− 7.6	30	− 8.7	7	−10.7
Aug. 12	− 4.9	1876, Jan. 1	− 9.4	May 3	−10.9	9	−10.9
15	− 6.3	7	− 8.0	28	− 9.3	12	−10.8
Sept. 15	− 7.9	10	−10.5	June 30	−11.3	Feb. 6	− 9.4
21	−10.9	Feb. 2	− 6.4	July 28	−11.1	Mar. 8	− 8.5
24	−10.3	16	− 9.7	Aug. 9	− 9.1	16	−13.1
Oct. 11	− 5.8	Mar. 4	− 8.4	10	− 9.1	18	−14.7
14	− 7.4	5	− 8.7	25	−11.3	May 4	− 8.7
15	− 8.4	6	− 9.4	28	−10.1	11	−12.6
Dec. 9	− 7.3	Apr. 1	− 8.6	Sept. 6	− 9.1	21	−13.3
1873, Jan. 22	− 7.0	4	− 9.3	26	− 9.7	July 5	−11.2
Mar. 1	− 8.4	7	− 9.8	Oct. 4	− 9.0	18	−12.5
5	− 8.2	11	− 9.2	24	− 9.6	Aug. 15	−12.6
Apr. 2	− 7.4	May 4	− 9.5	30	− 8.2	Sept. 3	−11.8
30	− 7.9	5	− 9.2	31	− 8.4	Oct. 3	−11.3
May 1	− 7.1	June 1	− 9.2	Nov. 16	−12.8	5	−11.2
5	− 5.3	5	− 8.2	18	−11.7	9	−11.6
11	− 5.8	29	− 9.5	22	− 8.6	31	−11.2
16	− 9.2	30	− 8.9	Dec. 1	−10.4	Nov. 1	−11.0
June 5	− 4.3	July 13	− 9.2	22	− 7.6	12	−10.3
July 1	− 4.9	16	−10.7	27	− 8.4	29	−11.1
2	− 4.5	Oct. 5	−10.1	1880, Jan. 16	− 9.2	Dec. 24	−13.1
4	− 4.1	6	−10.9	20	− 7.1	27	−11.7
19	−10.6	27	− 4.7	28	−11.7	30	−10.1
Aug. 6	− 6.3	Nov. 23	− 4.0	Feb. 5	−14.8	1882, Feb. 7	−13.1
9	− 8.7	24	− 4.2	12	−10.1	11	−14.3
10	− 9.7	29	− 7.6	18	− 6.8	12	−14.4
11	−10.1	30	− 8.6	Mar. 3	−16.1	Mar. 8	−14.4
12	−10.6	Dec. 26	− 6.3	4	−15.8	Apr. 1	−11.9
18	− 9.4	1877, Jan. 30	−12.2	13	− 8.4	20	−11.9
Oct. 3	− 7.0	Feb. 26	−10.4	18	− 6.5	May 6	−16.0
9	−10.9	Mar. 23	− 8.0	21	− 8.0	29	−12.3
13	− 9.9	26	− 9.6	25	−12.2	June 4	−16.1
Dec. 1	− 7.5	Apr. 22	− 9.0	30	−15.6	July 2	−13.6
24	− 6.1	26	− 9.8	Apr. 1	−15.6	21	−12.0
1874, Jan. 25	− 7.5	May 31	− 8.0	2	−15.0	Aug. 2	−15.5
26	− 7.5	July 6	− 8.5	11	− 8.1	18	−12.2
27	− 7.8	Aug. 29	− 9.1	16	− 7.6	27	−14.1
30	− 7.9	30	− 9.7	20	−11.2	Sept. 7	−13.3
Mar. 26	− 8.5	Sept. 18	− 7.0	26	−14.5	20	−12.2

Date.	Δv.
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1882, Oct. 1	−14.8
22	−11.7
24	−12.2
Nov. 2	−14.1
18	−12.1
26	−12.7
Dec. 5	−13.7
1883, Jan. 4	− 2.2
11	0.0
12	+ 0.6
13	+ 1.0
Feb. 14	− 1.4
Mar. 12	+ 1.4
Apr. 17	0.0
28	− 3.2
May 13	+ 1.0
17	− 0.3
June 14	− 0.4
July 15	− 1.0
17	− 1.3
19	− 1.6
21	− 2.0
Aug. 24	− 1.5
Sept. 6	− 1.6
7	− 1.5
14	− 0.7
16	− 1.0
Oct. 23	− 2.4
Nov. 13	+ 1.2
1884, Jan. 2	+ 0.9
7	+ 3.5
Feb. 6	+ 3.0
16	− 3.3
17	− 3.2
Mar. 3	+ 2.6
6	+ 2.1
8	+ 1.1
9	+ 0.3
15	− 3.0
24	− 0.1
Apr. 4	+ 1.3
6	− 0.2
30	+ 1.9
May 1	+ 1.6
2	+ 1.3
8	− 2.6
29	+ 1.3
30	+ 1.2
June 5	− 1.9
28	− 0.2
July 3	− 1.5
11	− 2.6
15	− 1.4
30	− 1.7
Aug. 15	− 0.8
Sept. 8	− 0.9
12	− 0.5
13	− 0.5
14	− 0.9
15	− 0.7
26	− 1.3
28	− 1.0
Oct. 9	− 0.8
28	+ 0.4
30	+ 0.8
Nov. 22	+ 0.3
25	+ 1.9
29	+ 2.5
Dec. 1	+ 1.8
30	+ 3.1
1885, Jan. 4	−0.8
20	+2.4
21	+3.0
22	+3.6
23	+4.4
24	+4.6
25	+4.2
26	+4.6
28	+3.4
Feb. 1	+0.3
20	+3.8
21	+4.5
22	+4.7
23	+4.8
24	+4.4
Mar. 4	−1.2
21	+3.6
22	+4.0
23	+4.2
27	+2.7
28	+2.1
Apr. 2	−1.7
4	−2.1
18	+3.4
19	+1.0
20	+3.6
21	+3.5
22	+3.1
24	+2.1
26	+0.7
May 5	−2.3
19	+3.2
22	+2.3
24	+0.7
June 23	−1.3
25	−2.2
28	−3.4
July 1	−2.9
6	−0.1
7	+0.6
9	+1.7
21	−0.6
22	−1.3
26	−2.6
Aug. 20	−1.8
31	−0.3
Sept. 1	+0.1
2	+0.6
5	+0.6
16	−2.5
17	−1.9
20	−1.7
21	−1.2
30	+0.6
Oct. 1	+0.6
14	−2.4
16	−2.1
Nov. 17	+0.4
22	+1.2
Dec. 2	−1.2
28	−1.6
1886, Jan. 14	+3.9
16	+4.5
18	+3.8
Feb. 9	+3.4
12	+5.3
13	+5.5
14	+5.6
Mar. 9	+3.2
Apr. 8	+4.1
1886, Apr. 10	+5.2
14	+4.5
15	+4.0
May 6	+3.6
14	+2.7
16	+0.9
21	−1.8
June 6	+4.3
10	+3.1
15	−0.5
July 8	+2.7
Aug. 8	+0.6
19	−1.2
24	+1.0
Sept. 5	−0.1
7	−0.4
Oct. 7	−1.1
22	+0.9
Nov. 1	−1.9
12	+0.6
14	+0.9
Dec. 3	−1.3
6	+0.2
18	+0.2
1887, Jan. 5	+2.0
6	+2.4
11	+1.3
12	+0.8
19	−2.1
28	−0.4
30	+1.1
Feb. 1	+2.3
4	+3.5
6	+3.1
7	+2.9
18	−3.2
Mar. 2	+3.8
8	+3.7
13	−1.3
14	−2.2
31	+4.8
Apr. 4	+5.2
6	+3.9
9	+0.5
15	−3.7
30	+5.4
May 1	+5.6
4	+4.1
June 3	+2.5
13	−2.9
July 1	+1.9
6	−2.2
16	+0.5
29	+1.8
Aug. 1	−0.6
5	−2.9
8	−2.7
14	+1.0
31	−1.9
Sept. 3	−2.7
13	+1.4
Oct. 12	+0.9
26	−1.1
28	−1.1
Nov. 7	+0.5
21	−1.5
22	−1.4
24	−1.1
Dec. 17	−1.6
27	+0.6
1888, Jan. 15	−1.6
27	+1.8
Mar. 9	−2.4
18	+1.9
25	+3.2
July 17	+4.0
20	+2.1
21	+1.1
23	−0.7
25	−1.6
28	−2.9
Aug. 17	+2.1
20	−0.5
Sept. 13	+2.4
16	+0.4
Oct. 9	+2.0
13	+0.7
15	−0.4
20	−2.1
Nov. 15	−1.2
Dec. 20	+0.4
1889, Jan. 8	−1.2
12	−0.6
14	−0.2
Feb. 5	−1.1
9	0.0
12	+0.8
Mar. 10	+1.0
11	+1.3
23	−1.1
Apr. 20	−1.4
June 5	+3.9
10	+3.5
July 19	−2.3
Aug. 8	+2.6
Sept. 4	+3.3
16	−1.1
30	+3.5
Oct. 5	+1.7
29	+2.1
Nov. 29	+1.2
Dec. 1	+0.8
29	+0.7
31	+0.4
1890, Jan. 3	+0.2
15	−1.9
Feb. 7	+0.4
12	+0.3
14	+0.2
Mar. 14	−0.4
Apr. 7	0.0
15	−1.2
28	+0.6
30	+1.7
May 3	+1.3
9	−1.3
30	+2.4
June 2	+1.2
4	−0.1
5	−0.5
6	−1.1
29	+2.4
July 12	−2.6
21	+1.8
Aug. 26	+3.0
Sept. 1	−1.5
6	−2.6
20	+3.3
27	+0.7
30	−1.1

Date.	Δv.	Date.	Δv.	Date.	Δv.	Date.	Δv.
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1890, Oct. 24	+1.6	1893, Feb. 26	+1.8	1894, Nov. 20	−2.1	1895, Sept. 5	+0.4
27	−0.2	Mar. 25	+2.1	Dec. 1	+2.0	6	0.0
Nov. 17	+2.4	Apr. 18	+1.7	2	+2.0	9	−1.0
20	+2.3	21	+2.0	8	+1.7	10	−1.2
21	+1.8	22	+2.0	10	+0.8	11	−1.6
Dec. 1	−1.4	23	+2.0	11	+0.4	15	−1.6
20	+1.4	May 6	−1.0	1895, Jan. 1	+2.8	29	+1.5
23	+0.5	8	−0.9	20	−1.5	30	+1.5
1891, Jan. 4	+0.2	June 24	+0.8	31	+3.1	Oct. 1	+1.4
Feb. 12	+0.5	July 1	−0.9	Feb. 6	+2.7	4	+0.4
17	+0.5	6	−1.3	7	+1.7	7	−0.8
20	+0.3	9	−1.0	8	+1.4	9	−1.7
21	+0.2	30	−0.8	13	−1.3	10	−1.7
Mar. 15	+0.2	Aug. 2	−1.2	18	−1.1	11	−1.8
19	+0.6	21	+0.5	Mar. 3	+3.2	28	+1.4
26	−1.0	Sept. 3	−1.5	4	+3.3	29	+1.4
28	−0.4	23	0.0	5	+3.3	31	+0.9
Apr. 15	+0.2	Oct. 19	+1.4	6	+3.3	Nov. 1	+0.5
18	+0.4	20	+1.2	8	+2.3	3	−0.4
20	+0.7	26	−1.4	9	+2.0	10	−1.5
25	−0.3	30	−2.2	10	+1.5	25	+1.9
May 4	−1.6	Nov. 19	+2.0	11	+0.9	27	+1.5
10	−0.7	22	+0.7	12	+0.4	28	+1.0
14	+0.2	24	−0.5	29	+2.0	29	+0.7
28	−2.1	Dec. 13	+2.6	30	+2.4	30	0.0
June 12	+0.5	20	+2.3	31	+2.5	Dec. 6	−2.4
July 18	+1.1	1894, Jan. 12	+2.9	Apr. 1	+2.8	10	−2.0
22	−1.2	16	+3.6	2	+2.9	28	+1.5
Aug. 14	+1.9	18	+3.1	3	+2.8	29	+0.5
18	+0.4	20	+2.1	4	+2.6	1896, Jan. 7	−2.9
20	−1.2	Feb. 13	+3.3	7	+1.7	8	−2.3
24	−2.9	15	+3.2	10	+0.6	19	+3.2
Oct. 12	+2.3	16	+3.1	11	+0.2	21	+3.6
14	+1.5	26	+0.4	12	+0.1	22	+3.4
15	+1.3	28	+0.4	28	+2.2	24	+2.8
Nov. 6	+1.9	Mar. 14	+2.7	29	+2.2	26	+1.9
7	+2.2	16	+2.6	30	+2.3	27	+1.2
10	+2.3	17	+2.4	May 1	+2.3	28	+0.3
19	−2.2	22	+1.2	2	+2.4	31	−1.9
1892, Jan. 19	−1.5	23	+0.7	3	+2.2	Feb. 19	+3.7
Feb. 1	+1.3	25	+0.8	4	+1.9	20	+3.8
7	+0.7	31	+1.4	5	+1.6	21	+3.5
23	−0.3	Apr. 9	+2.4	6	+1.4	22	+3.4
Mar. 8	−0.7	10	+2.5	7	+1.0	23	+3.0
16	−2.0	11	+2.5	9	+0.4	24	+2.5
Apr. 2	+0.5	12	+2.7	28	+2.2	26	+1.3
May 8	−0.2	24	+0.7	29	+2.2	Mar. 1	−1.4
13	−1.3	25	+0.7	30	+2.3	8	−0.9
June 8	−0.2	29	+1.4	31	+2.3	9	−0.5
14	−1.8	May 2	+1.6	June 9	−0.3	21	+3.2
July 4	+0.3	12	+2.4	12	−0.3	22	+3.2
6	+0.1	14	+2.2	13	−0.3	23	+3.0
11	−1.3	21	+0.1	15	−0.3	25	+2.2
13	−2.0	30	+0.6	16	0.0	27	+1.2
19	−2.0	July 15	+2.2	26	+1.9	Apr. 1	−1.0
Aug. 2	+0.6	17	+1.4	27	+1.9	7	+0.4
3	+0.6	Aug. 4	+0.2	July 2	+1.5	15	+2.3
4	+0.7	23	−1.4	9	−0.4	17	+2.5
11	−2.4	Sept. 11	+1.5	14	−0.6	19	+2.7
Sept. 6	−0.8	21	−1.5	15	−0.6	20	+2.5
7	−1.5	Oct. 7	+1.1	16	−0.6	22	+2.4
11	−3.0	10	+1.1	17	−0.5	25	+1.7
12	−3.0	11	+0.9	18	−0.2	26	+1.0
15	−2.5	19	+2.4	30	+1.8	May 1	+0.2
Oct. 3	+0.8	21	−1.6	Aug. 7	−0.3	16	+2.2
4	+0.4	23	−1.4	10	−0.8	17	+2.1
31	+2.3	Nov. 7	+1.6	12	−1.1	20	+2.0
Nov. 30	+2.4	9	+0.9	13	−1.2	21	+1.9
Dec. 12	−1.2	15	−1.9	16	−1.2	23	+1.3
25	+2.7	16	−2.5	Sept. 2	+1.1	25	+0.8

Date.	Δr.	Date.	Δr.	Date.	Δr.	Date.	Δr.
	″		″		″		″
1896, May 26	+0.6	1897, Aug. 14	+2.2	1899, May 12	+1.8	1901, Apr. 22	+1.1
31	+0.5	17	+3.2	26	−3.7	24	+1.5
June 2	+0.9	Sept. 9	+2.0	June 13	+1.9	28	+1.1
3	+0.9	18	+0.9	25	−3.5	May 5	−2.6
14	+2.0	Oct. 1	+1.4	July 18	−0.8	31	−1.7
15	+1.8	3	+2.1	20	−1.6	June 4	−3.5
19	+1.7	8	+3.0	Aug. 26	−1.4	5	−4.0
22	+1.1	30	+1.1	27	−1.0	12	−2.1
24	+0.9	Nov. 4	+3.1	Oct. 11	−0.1	22	+0.2
July 6	+1.4	Dec. 2	+2.5	12	+1.6	25	−0.3
20	+1.6	5	+3.1	27	−0.8	29	−2.3
27	+0.1	6	+3.2	Nov. 11	+0.9	July 10	−2.4
28	0.0	7	+3.0	13	+1.1	25	−1.4
31	+0.1	13	+0.1	14	+1.1	28	−2.3
Aug. 5	−1.2	25	−0.2	18	+0.3	Aug. 9	−1.8
20	+1.9	27	+0.8	Dec. 8	+0.1	19	−0.4
21	+1.5	1898, Jan. 2	+2.8	13	+1.8	22	−1.2
23	+1.1	3	+2.8	16	+1.0	24	−1.5
27	+0.2	5	+2.1	1900, Jan. 9	+1.5	30	−2.9
28	−0.1	10	−0.4	11	−0.7	Sept. 25	−1.4
29	+0.5	26	+1.9	23	−2.8	Oct. 17	−1.5
30	0.0	Feb. 5	+0.3	Feb. 3	−0.1	19	−0.9
Sept. 3	−0.5	13	−2.7	6	+1.1	21	−0.6
5	−0.5	25	+2.5	7	+0.3	23	−0.4
14	+1.9	Mar. 1	+2.9	12	+0.8	24	−0.4
18	+2.1	2	+2.2	Mar. 5	+0.5	27	−1.0
23	+1.0	5	+0.9	7	+1.2	29	−1.5
26	−0.3	13	−3.4	8	+1.4	Nov. 16	−0.7
28	−0.8	17	−1.8	23	−3.8	Dec. 18	+1.0
29	−0.9	26	+2.9	26	−3.1	19	+1.5
Oct. 9	−0.1	Apr. 1	+2.3	Apr. 2	−0.1	21	+1.6
10	−0.1	2	+1.1	4	+0.9	22	+1.6
16	+1.9	4	+0.3	5	+0.9	1902, Jan. 18	+2.5
18	+2.0	25	+2.4	May 1	+0.1	19	+2.6
24	+0.2	28	+2.2	7	+0.6	31	−1.8
25	−0.1	29	+2.4	16	−4.3	Feb. 12	+1.1
27	−0.6	May 2	+1.1	20	−3.7	13	+1.5
30	−1.1	16	−0.5	June 2	+0.6	14	+2.0
Nov. 9	+0.2	June 5	−1.5	8	−1.0	15	+2.4
10	+0.6	6	−1.5	14	−4.3	16	+2.8
12	+1.1	13	−0.4	July 6	−0.5	17	+2.7
13	+1.3	30	+2.9	10	−2.5	Mar. 17	+2.6
15	+1.5	July 30	+0.6	11	−3.3	20	+2.5
16	+1.6	Aug. 6	−0.5	Aug. 7	−1.6	25	−0.1
17	+1.4	25	+0.8	8	−2.1	28	−1.5
26	−1.4	Sept. 3	−0.3	17	−2.8	29	−1.8
Dec. 16	+1.1	23	+1.1	Sept. 1	−0.4	Apr. 21	+0.4
17	+1.8	28	+1.1	2	−0.5	May 10	+0.9
18	+0.7	Oct. 20	+0.7	4	−0.9	11	+1.5
1897, Jan. 7	+1.5	24	+2.1	12	−3.0	12	+1.6
10	+2.0	Nov. 16	−0.5	13	+1.8	14	+2.0
11	+2.1	22	+2.3	28	−0.4	15	+2.0
17	−0.2	Dec. 19	+0.8	Oct. 3	−0.3	17	+1.5
23	−2.7	23	+2.4	Nov. 13	−0.4	18	+1.0
27	−1.6	30	+0.9	26	−0.5	19	+0.8
Feb. 13	+1.5	1899, Jan. 19	+1.9	Dec. 5	+0.9	25	−2.4
23	−2.7	Feb. 2	−2.3	9	0.0	June 10	+1.2
Apr. 12	+2.8	4	−3.1	1901, Jan. 28	+1.9	15	+0.8
14	+1.8	18	+2.3	30	+2.4	17	−0.2
19	−1.5	19	+2.4	Feb. 15	−2.3	18	−0.6
May 5	+2.9	21	+2.0	21	−0.1	23	−2.6
11	+2.5	22	+1.6	25	+1.9	25	−3.2
July 3	+2.2	Mar. 16	+1.9	26	+2.2	27	−3.2
12	+0.8	20	+2.5	Mar. 10	−1.8	28	−3.0
13	+0.7	Apr. 15	+2.6	25	+1.4	July 11	+0.6
20	+3.5	17	+2.7	26	+1.9	15	−0.3
23	+2.2	19	+1.9	28	+2.2	18	−1.6
Aug. 1	−1.5	28	−4.2	Apr. 4	−0.4	19	−2.0
4	+1.7	May 1	−4.5	7	−2.2	21	−2.8
9	+1.4	3	−3.5	10	−2.9	22	−3.1

Date.	Δv.	Date.	Δv.	Date.	Δv.	Date.	Δv.
	″		″		″		″
1902, July 28	−2.6	1904, Jan. 4	−0.9	1905, Aug. 23	−0.9	1906, Oct. 26	−0.6
Oct. 10	−1.1	Feb. 24	+2.3	Sept. 9	+0.1	28	−1.0
11	−1.2	29	+1.7	11	−1.5	Nov. 5	−0.2
16	−1.9	Mar. 4	−0.9	12	−0.8	19	−0.6
19	−2.6	22	+2.2	17	−0.7	21	−0.8
21	−2.7	27	+2.6	18	−0.6	22	−0.8
22	−2.6	Apr. 22	+3.4	19	−0.1	Dec. 5	+0.8
23	−2.6	24	+3.2	Oct. 4	0.0	19	−1.8
24	−2.4	28	+0.6	11	−0.8	25	−1.6
Nov. 6	−1.2	May 1	−1.8	Nov. 7	−1.2	1907, Jan. 20	−1.9
8	−0.9	21	+3.3	Dec. 2	−1.7	26	0.0
11	−0.6	24	+2.5	9	−0.2	27	+0.5
14	−0.9	June 4	−3.1	10	0.0	Feb. 1	+0.5
17	−1.7	July 7	−1.4	1906, Jan. 1	−1.0	16	−1.5
18	−2.1	9	−0.3	4	+0.8	21	+0.6
19	−2.2	18	+1.7	6	+0.4	22	+1.4
20	−2.4	22	+0.5	10	+0.5	23	+1.3
22	−2.4	Aug. 30	−2.2	13	−0.1	25	+1.6
Dec. 4	−1.2	Sept. 13	−0.5	Feb. 3	+1.2	Mar. 10	−3.2
11	+0.6	22	−2.6	4	+1.7	20	+0.8
12	+0.6	27	−1.8	7	+1.8	21	+1.4
13	+0.1	29	−1.4	8	+1.6	22	+2.3
1903, Jan. 6	+1.1	Oct. 27	−1.3	Mar 2	+1.9	24	+3.0
9	+1.6	Nov. 20	−1.4	3	+2.3	28	+2.0
12	+1.0	23	−1.2	4	+3.0	Apr. 19	+2.3
14	−0.3	Dec. 16	−0.9	17	−3.2	25	+3.0
15	−0.7	20	0.0	20	−4.0	May 24	+3.3
18	−2.0	1905, Jan. 10	−1.7	29	+1.0	June 18	+3.6
19	−2.4	16	+1.4	31	+2.8	21	+2.7
20	−2.7	17	+1.2	Apr. 2	+3.6	24	+0.9
Feb. 2	+0.5	18	+1.5	3	+3.9	July 23	+0.9
6	+2.4	19	+1.4	4	+4.0	26	−2.9
7	+2.4	26	−2.1	5	+4.0	Aug. 18	+2.8
9	+2.0	Feb. 13	+2.3	6	+3.6	Sept. 14	+2.9
12	+0.6	17	+3.0	10	+0.2	15	+2.9
15	−1.6	20	+1.2	11	−0.4	16	+2.1
16	−2.1	21	+0.2	14	−3.0	18	+0.7
19	−3.2	Mar. 10	+0.6	27	+1.1	19	−0.4
Mar. 2	+1.3	12	+2.4	May 1	+4.3	24	−3.8
4	+1.6	15	+3.8	2	+4.3	26	−3.6
5	+2.4	16	+4.0	3	+4.7	Oct. 2	+0.3
6	+2.6	17	+3.8	8	+1.6	24	−2.6
7	+2.8	18	+3.2	9	0.0	Nov. 16	−0.8
8	+2.9	19	+2.8	11	−1.0	Dec. 11	−0.8
12	+1.0	20	+2.2	17	−3.8	17	−1.3
17	−2.4	Apr. 12	+4.0	June 2	+3.3	1908, Jan. 18	−0.3
Apr. 4	+2.8	15	+3.9	4	+2.3	29	+0.7
May 2	+2.4	16	+3.2	7	−0.5	Mar. 7	−1.8
June 2	+1.6	17	+2.8	8	−1.4	10	−1.0
Aug. 1	−1.3	24	−2.8	25	+4.6	13	0.0
Sept. 2	−2.4	May 10	+4.1	July 2	+2.6	23	−1.2
3	−2.6	13	+4.2	5	+1.9	Apr. 6	−0.7
Oct. 22	−2.1	14	+3.7	8	−3.2	9	+0.9
30	−1.6	15	+3.0	Aug. 9	−4.0	13	+1.5
Nov. 4	−1.7	July 7	+4.2	Sept. 1	−0.6	June 11	+2.7
9	−2.3	13	+1.3	5	−3.5	15	−0.5
Dec. 2	−0.4	20	−2.7	9	−2.6	16	−1.8
4	−0.8	Aug. 7	+2.6	Oct. 8	−0.5	July 17	+0.7
10	−2.4	12	+3.8	11	−0.2	Aug. 3	+3.1
31	+0.5	17	−1.9	25	0.0	9	+0.9
						10	0.0

CHAPTER VI.

POSITIONS OF THE OCCULTED STARS.

The positions of the occulted stars have been taken primarily from the Catalogue of Zodiacal Stars in Astronomical Papers of the American Ephemeris, Vol. VIII, Part III. The positions of the occulted stars observed by Batterman, published in Beobachtungs-Ergebnisse der Königlichen Sternwarte zu Berlin, Hefte 5, 11, und 13, have been used unchanged. The right ascensions as found in the printed catalogue are not corrected for the magnitude equation. This correction, however, has been applied to the adopted positions, or in many cases the final numbers have been corrected for this equation. The adopted expression for the magnitude equation is

$$\Delta\alpha = 0^s.008\,(4.0-m),$$

m being the magnitude of the star.

The positions of the stars occulted before 1847 were not corrected for this equation before being transformed into ecliptic coordinates. This transformation was made for the epoch 1900, the adopted obliquity being that of the author's Tables of the Sun,

$$\varepsilon = 23^\circ\ 27'\ 8''.26.$$

For convenient comparison with the positions used in Researches I, these longitudes and latitudes were reduced back to 1850.0, and were then corrected for the magnitude equation. The positions thus derived are given in the following list, in which is included the magnitude equation, which, however, it should be noted, is actually applied to derive the longitudes and latitudes as printed.

After reduction to the epoch of observation by the formulæ for precession and proper motion found in Chapter II, the positions are corrected for aberration. The adopted corrections are:

$$\Delta L = -20''.50 \sec B \cos(\odot - L),$$
$$\Delta B = -20''.50 \sin B \sin(\odot - L).$$

This value of the aberration is tabulated in the following tables, the arguments being in all cases the excess of the sun's longitude over that of the star.

The algebraic signs of the aberration for positive latitudes are shown at the top and bottom of the columns of arguments. It should be noted that the aberration in latitude changes sign with the latitude.

Table of Aberration Correction.

ΔL.

$\odot - L$		$B=0^\circ$	$B=2^\circ$	$B=4^\circ$	$B=6^\circ$	$B=8^\circ$	$\odot - L$	
+	−	″	″	″	″	″	+	−
180°	0°	20.50 $_{1}$	20.51 $_{1}$	20.55 $_{1}$	20.61 $_{1}$	20.70 $_{1}$	180°	360°
182	2	20.49 $_{4}$	20.50 $_{4}$	20.54 $_{4}$	20.60 $_{4}$	20.69 $_{4}$	178	358
184	4	20.45 $_{6}$	20.46 $_{6}$	20.50 $_{6}$	20.56 $_{6}$	20.65 $_{6}$	176	356
186	6	20.39 $_{9}$	20.40 $_{9}$	20.44 $_{9}$	20.50 $_{9}$	20.59 $_{9}$	174	354
188	8	20.30 $_{11}$	20.31 $_{11}$	20.35 $_{11}$	20.41 $_{11}$	20.50 $_{11}$	172	352
190	10	20.19 $_{14}$	20.20 $_{14}$	20.24 $_{14}$	20.30 $_{14}$	20.39 $_{14}$	170	350
192	12	20.05 $_{16}$	20.06 $_{16}$	20.10 $_{16}$	20.16 $_{16}$	20.25 $_{16}$	168	348
194	14	19.89 $_{19}$	19.90 $_{18}$	19.94 $_{19}$	20.00 $_{19}$	20.09 $_{19}$	166	346
196	16	19.70 $_{21}$	19.72 $_{21}$	19.75 $_{21}$	19.81 $_{21}$	19.90 $_{21}$	164	344
198	18	19.49 $_{23}$	19.51 $_{23}$	19.54 $_{23}$	19.60 $_{23}$	19.69 $_{23}$	162	342
+	−						+	−

***Table of Aberration Correction*—Continued.**

ΔL.

⊙−L		B=0°	B=2°	B=4°	B=6°	B=8°	⊙−L	
+	−	″	″	″	″	″	+	−
200°	20°	19.26 $_{25}$	19.28 $_{26}$	19.31 $_{25}$	19.37 $_{26}$	19.46 $_{26}$	160°	340°
202	22	19.01 $_{28}$	19.02 $_{28}$	19.06 $_{28}$	19.11 $_{28}$	19.20 $_{29}$	158	338
204	24	18.73 $_{31}$	18.74 $_{30}$	18.78 $_{31}$	18.83 $_{31}$	18.91 $_{31}$	156	336
206	26	18.42 $_{32}$	18.44 $_{33}$	18.47 $_{33}$	18.52 $_{32}$	18.60 $_{33}$	154	334
208	28	18.10 $_{35}$	18.11 $_{35}$	18.14 $_{35}$	18.20 $_{35}$	18.27 $_{35}$	152	332
210	30	17.75 $_{37}$	17.76 $_{37}$	17.79 $_{37}$	17.85 $_{37}$	17.92 $_{37}$	150	330
212	32	17.38 $_{39}$	17.39 $_{39}$	17.42 $_{39}$	17.48 $_{39}$	17.55 $_{39}$	148	328
214	34	16.99 $_{41}$	17.00 $_{41}$	17.03 $_{41}$	17.09 $_{41}$	17.16 $_{41}$	146	326
216	36	16.58 $_{43}$	16.59 $_{43}$	16.62 $_{43}$	16.68 $_{44}$	16.75 $_{44}$	144	324
218	38	16.15 $_{45}$	16.16 $_{45}$	16.19 $_{45}$	16.24 $_{45}$	16.31 $_{46}$	142	322
220	40	15.70 $_{47}$	15.71 $_{47}$	15.74 $_{47}$	15.79 $_{47}$	15.85 $_{47}$	140	320
222	42	15.23 $_{48}$	15.24 $_{48}$	15.27 $_{49}$	15.32 $_{49}$	15.38 $_{49}$	138	318
224	44	14.75 $_{51}$	14.76 $_{51}$	14.78 $_{51}$	14.83 $_{51}$	14.89 $_{51}$	136	316
226	46	14.24 $_{52}$	14.25 $_{52}$	14.27 $_{52}$	14.32 $_{53}$	14.38 $_{53}$	134	314
228	48	13.72 $_{54}$	13.73 $_{54}$	13.75 $_{54}$	13.79 $_{54}$	13.85 $_{54}$	132	312
230	50	13.18 $_{56}$	13.19 $_{56}$	13.21 $_{56}$	13.25 $_{56}$	13.31 $_{57}$	130	310
232	52	12.62 $_{57}$	12.63 $_{57}$	12.65 $_{57}$	12.69 $_{58}$	12.74 $_{58}$	128	308
234	54	12.05 $_{59}$	12.06 $_{59}$	12.08 $_{59}$	12.11 $_{59}$	12.16 $_{59}$	126	306
236	56	11.46 $_{60}$	11.47 $_{60}$	11.49 $_{61}$	11.52 $_{60}$	11.57 $_{61}$	124	304
238	58	10.86 $_{61}$	10.87 $_{61}$	10.88 $_{61}$	10.92 $_{62}$	10.96 $_{61}$	122	302
240	60	10.25 $_{62}$	10.26 $_{63}$	10.27 $_{63}$	10.30 $_{62}$	10.35 $_{63}$	120	300
242	62	9.63 $_{64}$	9.63 $_{64}$	9.64 $_{64}$	9.68 $_{64}$	9.72 $_{65}$	118	298
244	64	8.99 $_{65}$	8.99 $_{64}$	9.00 $_{64}$	9.04 $_{66}$	9.07 $_{65}$	116	296
246	66	8.34 $_{66}$	8.35 $_{66}$	8.36 $_{66}$	8.38 $_{66}$	8.42 $_{66}$	114	294
248	68	7.68 $_{67}$	7.69 $_{68}$	7.70 $_{67}$	7.72 $_{67}$	7.76 $_{68}$	112	292
250	70	7.01 $_{68}$	7.01 $_{68}$	7.03 $_{68}$	7.05 $_{68}$	7.08 $_{69}$	110	290
252	72	6.33 $_{68}$	6.33 $_{68}$	6.35 $_{69}$	6.37 $_{69}$	6.39 $_{69}$	108	288
254	74	5.65 $_{69}$	5.65 $_{69}$	5.66 $_{69}$	5.68 $_{69}$	5.70 $_{70}$	106	286
256	76	4.96 $_{70}$	4.96 $_{70}$	4.97 $_{70}$	4.99 $_{71}$	5.00 $_{70}$	104	284
258	78	4.26 $_{70}$	4.26 $_{70}$	4.27 $_{70}$	4.28 $_{70}$	4.30 $_{71}$	102	282
260	80	3.56 $_{71}$	3.56 $_{71}$	3.57 $_{71}$	3.58 $_{71}$	3.59 $_{71}$	100	280
262	82	2.85 $_{71}$	2.85 $_{71}$	2.86 $_{71}$	2.87 $_{72}$	2.88 $_{72}$	98	278
264	84	2.14 $_{71}$	2.14 $_{71}$	2.15 $_{72}$	2.15 $_{71}$	2.16 $_{72}$	96	276
266	86	1.43 $_{71}$	1.43 $_{71}$	1.43 $_{71}$	1.44 $_{72}$	1.44 $_{72}$	94	274
268	88	0.72 $_{72}$	0.72 $_{72}$	0.72 $_{72}$	0.72 $_{72}$	0.72 $_{72}$	92	272
270	90	0.00	0.00	0.00	0.00	0.00	90	270
+	−						+	−

ΔB.

⊙−L		B=0°	B=1°	B=2°	B=3°	B=4°	B=5°	B=6°	B=7°	⊙−L	
+	−	″	″	″	″	″	″	″	″	−	+
180°	0°	0.00	0.00 $_{3}$	0.00 $_{6}$	0.00 $_{9}$	0.00 $_{13}$	0.00 $_{16}$	0.00 $_{19}$	0.00 $_{22}$	180°	360°
185	5	0.00	0.03 $_{3}$	0.06 $_{6}$	0.09 $_{10}$	0.13 $_{12}$	0.16 $_{15}$	0.19 $_{18}$	0.22 $_{21}$	175	355
190	10	0.00	0.06 $_{3}$	0.12 $_{6}$	0.19 $_{9}$	0.25 $_{12}$	0.31 $_{15}$	0.37 $_{18}$	0.43 $_{22}$	170	350
195	15	0.00	0.09 $_{3}$	0.18 $_{6}$	0.28 $_{9}$	0.37 $_{12}$	0.46 $_{15}$	0.55 $_{18}$	0.65 $_{20}$	165	345
200	20	0.00	0.12 $_{3}$	0.24 $_{6}$	0.37 $_{8}$	0.49 $_{12}$	0.61 $_{14}$	0.73 $_{17}$	0.85 $_{20}$	160	340
205	25	0.00	0.15 $_{3}$	0.30 $_{6}$	0.45 $_{9}$	0.61 $_{11}$	0.75 $_{14}$	0.90 $_{17}$	1.05 $_{20}$	155	335
210	30	0.00	0.18 $_{3}$	0.36 $_{5}$	0.54 $_{7}$	0.72 $_{10}$	0.89 $_{13}$	1.07 $_{16}$	1.25 $_{18}$	150	330
215	35	0.00	0.21 $_{2}$	0.41 $_{5}$	0.61 $_{8}$	0.82 $_{10}$	1.02 $_{13}$	1.23 $_{15}$	1.43 $_{18}$	145	325
220	40	0.00	0.23 $_{2}$	0.46 $_{5}$	0.69 $_{7}$	0.92 $_{9}$	1.15 $_{11}$	1.38 $_{14}$	1.61 $_{16}$	140	320
225	45	0.00	0.25 $_{2}$	0.51 $_{4}$	0.76 $_{6}$	1.01 $_{9}$	1.26 $_{11}$	1.52 $_{12}$	1.77 $_{14}$	135	315
230	50	0.00	0.27 $_{2}$	0.55 $_{3}$	0.82 $_{6}$	1.10 $_{7}$	1.37 $_{9}$	1.64 $_{11}$	1.91 $_{14}$	130	310
235	55	0.00	0.29 $_{2}$	0.58 $_{4}$	0.88 $_{5}$	1.17 $_{7}$	1.46 $_{9}$	1.75 $_{10}$	2.05 $_{11}$	125	305
240	60	0.00	0.31 $_{2}$	0.62 $_{3}$	0.93 $_{4}$	1.24 $_{6}$	1.55 $_{7}$	1.85 $_{9}$	2.16 $_{11}$	120	300
245	65	0.00	0.33 $_{1}$	0.65 $_{2}$	0.97 $_{4}$	1.30 $_{4}$	1.62 $_{6}$	1.94 $_{8}$	2.27 $_{8}$	115	295
250	70	0.00	0.34 $_{1}$	0.67 $_{2}$	1.01 $_{3}$	1.34 $_{4}$	1.68 $_{5}$	2.02 $_{5}$	2.35 $_{6}$	110	290
255	75	0.00	0.35 $_{0}$	0.69 $_{1}$	1.04 $_{2}$	1.38 $_{3}$	1.73 $_{3}$	2.07 $_{4}$	2.41 $_{5}$	105	285
260	80	0.00	0.35 $_{1}$	0.70 $_{1}$	1.06 $_{1}$	1.41 $_{1}$	1.76 $_{2}$	2.11 $_{2}$	2.46 $_{3}$	100	280
265	85	0.00	0.36 $_{0}$	0.71 $_{1}$	1.07 $_{0}$	1.42 $_{1}$	1.78 $_{0}$	2.13 $_{1}$	2.49 $_{1}$	95	275
270	90	0.00	0.36	0.72	1.07	1.43	1.78	2.14	2.50	90	270
+	−									−	+

NOTE.—For *B* negative, change sign of Δ*B*.

Longitude and Latitude of Stars Occulted before 1862, Referred to the Equinox of 1850.0.

Name of Star.	Mag.	Longitude, 1850.	Centennial Variation.	Proper Motion.	Latitude, 1850.	Centennial Variation.	Proper Motion.	Mag. Eq.	
								ΔL.	ΔB.
		° ′ ″	″	″	° ′ ″	″	″	″	″
10 Ceti	6.4	3 59 35.76	5034.94	+ 8.25	−2 41 26.64	+ 6.26	− 2.33	−0.26	+0.11
44 Piscium	6.1	4 30 15.52	5022.26	− 2.86	−0 44 38.39	+ 7.71	− 1.28	−0.22	+0.09
45 Piscium	7.2	6 50 58.42	5022.53	+ 1.62	+4 30 37.42	+ 4.22	− 6.67	−0.40	+0.16
60 Piscium	6.2	11 25 47.38	5024.59	+ 1.25	+1 31 4.78	+13.46	− 1.06	−0.26	+0.11
62 Piscium	6.1	11 50 55.16	5032.96	+ 9.95	+1 56 49.02	+11.45	− 3.39	−0.24	+0.10
δ Piscium	4.5	12 3 4.62	5028.58	+ 5.74	+2 10 24.15	+ 7.76	− 7.24	−0.07	+0.03
171 B. Piscium	6.3	14 10 36.83	5025.36	+ 0.90	+0 5 4.02	+15.74	− 0.90	−0.28	+0.25
33 Ceti	6.1	15 6 20.35	5026.41	− 1.70	−4 40 8.79	+17.36	0.00	−0.28	+0.24
ε Piscium	4.4	15 26 2.42	5017.25	− 6.45	+1 5 2.75	+23.09	+ 5.48	−0.06	+0.25
35 Ceti	6.8	15 34 33.08	5008.31	−19.91	−4 49 46.79	+15.56	− 2.16	−0.34	+0.13
c Piscium	5.6	15 50 1.73	4994.31	−31.36	−1 29 45.36	+12.41	− 5.50	−0.20	+0.12
f Piscium	5.3	17 13 45.45	5022.17	− 5.58	−4 16 18.63	+18.50	− 0.47	−0.14	+0.14
ζ Piscium	5.3	17 46 42.73	5035.86	+11.17	−0 13 2.65	+ 9.16	−10.23	−0.02	+0.01
88 Piscium	6.2	17 47 20.16	5022.62	− 2.55	−0 50 58.29	+17.63	− 1.77	−0.25	+0.14
95 Piscium	7.3	20 9 58.53	5018.06	− 9.10	−3 34 19.54	+ 9.49	−11.67	−0.48	+0.19
μ Piscium	5.0	21 1 45.49	5053.36	+26.59	−3 4 0.80	+ 8.26	−13.54	−0.14	+0.13
96 Piscium	6.7	21 12 14.39	5021.64	− 4.27	−1 53 54.14	+17.88	− 4.04	−0.32	+0.12
ν Piscium	4.6	23 24 41.92	5025.95	− 1.94	−4 42 16.42	+24.62	+ 1.11	−0.08	+0.03
η Piscium	3.8	24 43 19.93	5022.66	+ 1.91	+5 22 4.26	+23.39	− 1.05	+0.04	−0.03
π Piscium	5.6	24 49 21.84	5017.74	− 5.47	+1 53 1.54	+30.36	+ 5.85	−0.19	+0.07
101 Piscium	6.2	25 26 19.25	5022.78	+ 1.30	+4 21 4.05	+24.26	− 0.68	−0.31	+0.12
ο Piscium	4.5	25 38 41.17	5034.07	+ 8.40	−1 37 53.93	+26.65	+ 1.56	−0.05	+0.18
104 Piscium	6.9	26 5 10.05	5028.89	+ 6.93	+3 41 47.03	+19.47	− 5.93	−0.42	+0.15
54 Ceti	6.0	27 34 47.17	5017.23	− 7.53	−0 20 43.39	+26.38	− 0.04	−0.22	+0.07
311 B. Piscium	7.1	27 56 6.85	5033.49	+ 5.00	−5 49 21.14	+22.15	− 4.51	−0.37	+0.17
64 Ceti	5.8	31 28 29.84	5010.91	−16.48	−4 24 4.92	+23.57	− 5.44	−0.20	+0.07
ξ^1 Ceti	4.6	31 56 48.52	5024.99	− 2.30	−4 16 45.40	+28.43	− 0.89	−0.06	+0.02
ξ Arietis	5.5	35 16 56.43	5026.79	+ 0.06	−3 34 0.79	+29.07	− 2.34	−0.17	+0.07
ξ^2 Ceti	4.3	35 22 21.34	5031.49	+ 3.35	−5 52 4.82	+29.61	− 1.86	−0.05	+0.02
31 Arietis	5.7	38 36 12.79	5049.82	+23.70	−2 43 49.81	+16.63	−16.77	−0.19	+0.06
27 Arietis	6.4	38 56 24.58	5024.01	+ 1.04	+2 41 28.22	+23.85	− 9.75	−0.30	+0.09
85 Ceti	6.3	39 27 30.39	5023.30	− 3.98	−4 47 58.58	+33.90	+ 0.01	−0.28	+0.08
μ Ceti	4.3	39 50 6.03	5053.50	+25.80	−5 34 34.20	+23.24	−10.87	−0.05	+0.02
38 Arietis	5.2	40 32 54.41	5035.30	+ 8.89	−3 21 12.34	+23.39	−11.12	−0.14	+0.05
μ Arietis	5.7	42 14 13.05	5024.25	+ 1.92	+4 2 45.34	+30.79	− 4.65	−0.22	+0.06
σ Arietis	5.4	42 50 55.00	5026.49	+ 1.26	−1 18 28.25	+31.79	− 3.98	−0.18	+0.05
40 Arietis	6.0	43 6 38.60	5026.94	+ 3.46	+1 57 40.09	+32.78	− 3.13	−0.25	+0.11
ρ Arietis	5.6	44 49 27.59	5044.59	+20.67	+1 10 34.37	+ 8.76	−28.04	−0.18	+0.04
47 Arietis	5.8	45 57 9.06	5043.70	+20.98	+3 35 35.64	+28.85	− 8.53	−0.23	+0.06
ε Arietis (mean)	4.6	46 24 19.28	5020.92	− 1.54	+4 9 31.70	+37.04	− 0.57	−0.07	+0.03
53 Arietis	6.0	47 18 15.61	5021.84	− 2.54	+0 17 48.86	+39.16	+ 1.11	−0.32	+0.09
54 Arietis	6.5	47 45 41.91	5026.09	+ 2.10	+1 7 10.48	+36.21	− 2.05	−0.30	+0.08
δ Arietis	4.5	48 45 10.75	5038.63	+14.95	+1 48 35.10	+34.58	− 4.17	−0.06	+0.02
ζ Arietis	4.8	49 51 1.45	5018.44	− 4.77	+2 52 40.66	+32.07	− 7.17	−0.11	+0.03
161 B. Arietis	6.9	50 12 44.37	5032.27	+ 9.89	+4 45 20.98	+32.76	− 6.65	−0.35	+0.10
τ Arietis	5.1	51 18 3.81	5025.66	+ 2.27	+2 35 38.18	+35.88	− 4.02	−0.14	+0.04
f Tauri	4.3	51 29 47.73	5029.46	+ 2.33	−5 55 55.96	+39.58	− 0.39	−0.04	+0.01
65 Arietis	6.0	51 56 25.55	5024.21	+ 0.57	+2 4 17.79	+39.21	− 0.96	−0.19	+0.05
66 Arietis	6.1	53 20 23.14	5020.92	− 2.05	+3 47 1.04	+29.75	−11.01	−0.25	+0.10
7 Tauri	5.9	55 4 40.31	5023.77	+ 1.23	+5 3 38.01	+38.81	− 2.65	−0.23	+0.03
14 H¹. Tauri	6.5	55 16 20.66	5024.00	....	+1 21 52.54	+41.53	....	−0.30	+0.07
9 Tauri	6.7	55 20 44.05	5022.19	− 0.90	+3 42 22.76	+38.02	− 3.54	−0.36	+0.09
14 Tauri	6.2	56 4 40.44	5035.07	+10.50	−0 6 19.74	+34.35	− 7.49	−0.26	+0.06
22 H¹. Tauri	6.1	56 31 6.88	5025.05	+ 0.93	+1 5 18.38	+41.19	− 0.82	−0.25	+0.05
17 Tauri	3.8	57 19 4.21	5023.62	+ 1.01	+4 10 27.19	+37.52	− 5.39	+0.02	−0.01
16 Tauri	5.4	57 20 27.92	5023.56	+ 0.10	+4 20 58.26	+37.53	− 5.03	−0.30	+0.07
q Tauri	4.3	57 28 14.16	5023.51	+ 0.57	+4 30 8.78	+37.57	− 3.62	−0.04	+0.01
18 Tauri	5.6	57 32 35.83	5023.38	− 0.27	+4 52 3.13	+37.59	− 3.81	−0.28	+0.06
20 Tauri	4.1	57 35 10.80	5023.56	+ 1.15	+4 22 27.50	+37.61	− 4.77	0.00	0.00
23 Tauri	4.3	57 36 18.68	5023.72	+ 1.07	+3 56 24.34	+37.62	− 5.43	−0.02	+0.01
21 Tauri	5.8	57 38 44.73	5023.50	+ 0.62	+4 33 9.16	+37.63	− 4.85	−0.22	+0.03
22 Tauri	6.5	57 40 16.06	5023.51	− 0.01	+4 31 9.63	+37.64	− 4.02	−0.30	+0.07
η Tauri	2.9	57 53 53.95	5023.70	+ 1.01	+4 2 6.77	+37.72	− 5.34	+0.12	−0.03
27 Tauri	3.7	58 15 42.81	5023.77	+ 0.61	+3 54 6.08	+37.85	− 5.08	+0.02	−0.01
28 Tauri	5.2	58 17 7.23	5023.32	+ 0.19	+3 58 55.09	+37.86	− 4.82	−0.26	+0.06

The above longitudes and latitudes include the magnitude equation.

Longitude and Latitude of Stars Occulted before 1862, Referred to the Equinox of 1850.0—Continued.

Name of Star.	Mag.	Longitude, 1850.	Centennial Variation.	Proper Motion.	Latitude, 1850.	Centennial Variation.	Proper Motion.	Mag. Eq.	
								ΔL.	ΔB.
		° ′ ″	″	″	° ′ ″	″	″	″	″
33 Tauri	6.0	59 51 0.35	5027.02	+ 3.37	+2 39 45.37	+41.51	− 1.67	−0.36	+0.08
A Tauri	4.5	61 21 28.74	5032.47	+ 8.32	+1 14 40.86	+36.06	− 7.62	−0.06	+0.01
39 Tauri	6.1	61 29 14.63	5038.56	+14.39	+1 8 53.28	+27.40	−16.30	−0.25	+0.05
36 Tauri	5.6	61 40 31.77	5023.20	− 0.34	+3 14 35.18	+41.56	− 2.20	−0.19	+0.04
43 Tauri	5.5	61 55 0.35	5035.05	+10.11	−1 22 53.39	+37.35	− 6.48	−0.22	+0.05
48 Tauri	6.3	62 42 27.47	5037.91	+11.68	−5 48 19.06	+39.46	− 4.62	−0.29	+0.06
p Tauri	5.5	63 33 54.10	5019.09	− 3.95	+5 18 5.63	+40.81	− 3.51	−0.19	+0.04
γ Tauri	3.9	63 42 22.42	5037.59	+11.45	−5 44 56.31	+39.67	− 4.69	+0.01	0.00
58 Tauri	5.4	63 48 36.27	5036.20	+ 9.91	−6 18 24.40	+40.93	− 3.45	−0.13	+0.03
ω Tauri	4.8	63 57 59.72	5020.64	− 4.10	−0 46 3.77	+39.59	− 4.84	−0.07	+0.02
51 Tauri	5.6	64 23 28.47	5033.54	+ 9.06	+0 10 23.25	+38.77	− 5.77	−0.17	+0.03
53 Tauri	5.3	64 33 37.23	5027.63	+ 3.02	−0 17 56.78	+38.88	− 5.71	−0.18	+0.03
56 Tauri	5.2	64 42 26.37	5028.06	+ 3.62	+0 18 57.19	+39.95	− 4.68	−0.17	+0.03
63 Tauri	5.7	64 45 37.07	5035.90	+10.11	−4 45 36.32	+40.17	− 4.48	−0.19	+0.03
δ Tauri	3.9	64 46 18.51	5035.74	+10.15	−3 59 10.42	+39.80	− 4.85	0.00	0.00
64 Tauri	4.9	65 1 46.13	5036.74	+11.13	−4 7 41.27	+38.78	− 5.93	−0.11	+0.02
70 Tauri	6.4	65 8 54.18	5036.00	+10.02	−5 40 15.30	+40.41	− 4.34	−0.29	+0.05
71 Tauri	4.6	65 16 9.16	5036.52	+10.44	−6 1 2.61	+41.03	− 3.74	−0.07	+0.01
68 Tauri	4.3	65 26 10.13	5035.89	+10.42	−3 42 15.45	+39.93	− 4.90	−0.02	0.00
φ Tauri	5.0	65 49 5.74	5019.16	− 3.92	+5 47 9.67	+37.30	− 7.62	−0.13	+0.02
θ¹ Tauri	4.2	65 51 22.36	5035.76	+ 9.79	−5 45 43.13	+41.00	− 3.93	+0.01	0.00
θ² Tauri	3.6	65 51 46.22	5036.88	+10.89	−5 51 19.73	+41.08	− 3.85	+0.05	−0.01
75 Tauri	5.2	65 53 23.56	5026.51	+ 0.64	−5 22 0.88	+46.81	+ 1.87	−0.16	+0.03
χ Tauri	5.3	66 1 17.54	5026.83	+ 3.29	+4 0 12.78	+41.50	− 3.47	−0.20	+0.03
κ Tauri	4.1	66 6 22.72	5032.22	+ 7.84	+0 36 38.27	+39.39	− 5.60	−0.07	+0.01
62 Tauri	6.1	66 7 17.98	5024.60	+ 0.72	+2 38 25.11	+42.97	− 2.02	−0.26	+0.04
80 Tauri	5.8	66 10 51.33	5034.38	+ 8.36	−6 8 26.31	+42.51	− 2.50	−0.19	+0.03
81 Tauri	5.5	66 18 36.00	5031.41	+ 9.39	−6 6 21.19	+40.31	− 4.73	−0.18	+0.03
264 B. Tauri	4.8	66 21 56.26	5037.47	+11.58	−5 36 22.50	+40.50	− 4.55	−0.22	+0.04
ε Tauri	3.5	66 21 58.57	5036.05	+10.90	−2 35 1.64	+39.80	− 5.26	+0.04	−0.01
υ Tauri	4.2	66 24 8.93	5034.24	+ 9.97	+1 5 21.72	+38.57	− 6.49	−0.07	+0.01
247 B. Tauri	5.8	66 36 19.67	5033.39	+ 8.83	−0 9 5.03	+35.90	− 9.20	−0.22	+0.04
85 Tauri	6.0	66 37 28.88	5035.74	+ 9.78	−5 59 31.33	+41.52	− 3.59	−0.30	+0.04
275 B. Tauri	6.5	67 7 18.67	5027.52	+ 1.69	−5 35 23.31	+46.90	+ 1.67	−0.30	+0.04
α Tauri	1.1	67 41 34.49	5029.62	+ 3.86	−5 28 41.01	+25.63	+ 9.73	+0.36	−0.05
σ² Tauri	4.9	68 24 31.54	5034.43	+ 8.57	−6 11 1.51	+42.33	− 3.19	−0.10	+0.02
τ Tauri	4.3	70 3 34.45	5025.06	+ 0.67	+0 41 43.60	+43.78	− 2.07	−0.05	+0.01
95 Tauri	6.2	70 25 54.32	5025.71	+ 1.51	+1 47 17.38	+42.70	− 3.22	−0.34	+0.05
i Tauri	5.1	71 39 27.08	5032.98	+ 7.83	−3 39 16.50	+41.64	− 4.50	−0.13	+0.02
318 B. Tauri	5.7	72 53 31.49	5024.09	− 1.27	−5 29 32.28	+45.41	− 0.93	−0.20	+0.03
99 Tauri	6.0	73 43 21.87	5024.41	+ 0.06	+1 15 10.13	+42.95	− 3.51	−0.24	+0.04
k Tauri	5.6	73 55 3.40	5026.65	+ 2.44	+2 20 29.26	+40.05	− 6.43	−0.20	+0.03
ι Tauri	4.7	74 41 27.33	5031.91	+ 7.23	−1 12 59.90	+40.87	− 5.72	−0.08	+0.01
330 B. Tauri	6.3	74 57 20.10	5028.19	+ 3.47	−1 33 23.74	+42.85	− 3.76	−0.28	+0.02
m Tauri	5.0	75 24 43.42	5079.26	+54.24	−4 14 43.74	+43.81	− 2.87	−0.13	+0.01
l Tauri	5.2	75 40 51.08	5019.67	− 5.14	−2 29 13.14	+41.77	− 4.93	−0.18	+0.01
105 Tauri	6.0	75 49 17.20	5025.09	+ 0.43	−1 12 33.14	+45.94	− 0.78	−0.22	+0.02
n Tauri	5.1	78 28 40.40	5026.82	+ 2.22	−1 1 34.91	+38.48	− 8.48	−0.14	+0.01
111 Tauri	5.1	79 22 0.44	5048.95	+24.08	−5 48 41.10	+44.37	− 2.65	−0.14	+0.01
115 Tauri	5.3	80 4 0.75	5026.89	+ 2.10	−5 16 21.30	+44.77	− 2.28	−0.17	+0.01
117 Tauri	6.0	80 13 51.05	5026.81	+ 2.00	−6 0 17.76	+39.16	− 7.91	−0.30	+0.02
o Tauri	4.8	80 24 6.19	5025.39	+ 0.80	−1 18 39.81	+46.08	− 1.00	−0.10	+0.01
118 Tauri	5.4	80 57 8.62	5026.32	+ 1.86	+1 52 41.46	+43.13	− 3.97	−0.17	+0.01
119 Tauri	4.9	81 18 3.09	5025.70	+ 1.02	−4 42 19.37	+46.69	− 0.42	−0.07	+0.01
120 Tauri	5.6	81 36 38.01	5026.22	+ 1.56	−4 46 26.98	+47.09	− 0.03	−0.16	+0.01
121 Tauri	5.1	82 18 6.83	5025.71	+ 1.19	+0 42 3.13	+43.94	− 3.19	−0.17	+0.01
107 B. Aurigæ	6.5	82 33 46.20	5022.35	− 2.12	+4 19 0.32	+39.64	− 7.50	−0.30	+0.02
ζ Tauri	3.0	82 41 25.26	5025.18	+ 0.63	−2 12 51.55	+43.91	− 3.23	+0.12	−0.01
112 B. Aurigæ	5.7	82 48 11.66	5023.82	− 0.67	+3 34 3.20	+43.22	− 3.92	−0.20	+0.02
125 Tauri	5.1	83 20 41.02	5026.77	+ 2.25	+2 31 9.85	+44.10	− 3.04	−0.11	+0.01
126 Tauri	4.8	83 23 27.21	5026.69	+ 2.15	−6 51 3.24	+45.19	− 1.95	−0.11	+0.01
130 Tauri	5.6	84 53 58.78	5024.99	+ 0.57	−5 41 48.31	+46.21	− 0.92	−0.18	+0.01
132 Tauri	5.0	85 24 28.96	5024.52	− 0.04	+1 8 0.22	+44.81	− 2.31	−0.13	+0.01
406 B. Tauri	5.6	85 54 19.65	5023.00	− 1.70	+4 31 27.28	+48.24	+ 1.14	−0.19	+0.02
136 Tauri	4.6	86 25 24.38	5026.37	+ 1.66	+3 9 44.96	+45.01	− 2.07	−0.06	0.00

$\Delta_2 L = +(1''.11 + 0''.20 \tan B \sin (L + 16^\circ))\, T^2$; $\Delta_2 B = +0''.20\, T^2 \cos (L + 16^\circ)$.

Longitude and Latitude of Stars Occulted before 1862, Referred to the Equinox of 1850.0—Continued.

Name of Star.		Mag.	Longitude, 1850.	Centennial Variation.	Proper Motion.	Latitude, 1850.	Centennial Variation.	Proper Motion.	Mag. Eq. ΔL.	Mag. Eq. ΔB.
			° ′ ″	″	″	° ′ ″	″	″	″	″
χ¹	Orionis	4.5	86 35 39.26	5006.46	−17.93	−3 10 22.30	+38.93	− 8.15	−0.08	0.00
57	Orionis	5.8	86 42 50.04	5024.70	+ 0.34	−3 42 13.73	+45.73	− 1.34	−0.23	0.00
139	Tauri	4.7	87 27 16.17	5024.70	+ 0.03	+2 29 45.62	+46.36	− 0.67	−0.13	0.00
141	Tauri	6.3	88 17 51.58	5023.20	− 1.26	−1 3 23.19	+45.89	− 1.09	−0.32	0.00
64	Orionis	5.1	88 43 14.75	5026.18	+ 1.93	−3 45 54.17	+44.86	− 2.09	−0.13	0.00
χ²	Orionis	4.7	88 49 38.03	5025.80	+ 1.52	−3 19 1.50	+46.64	− 0.30	−0.10	0.00
1	Geminorum	4.1	88 51 8.15	5024.77	+ 0.25	−0 11 15.99	+36.05	−10.88	−0.04	0.00
2	Geminorum	6.9	89 27 56.22	5025.93	+ 1.38	+0 11 20.94	+45.82	− 1.06	−0.38	0.00
3	Geminorum	5.6	90 8 36.77	5026.38	+ 1.88	−0 19 34.56	+46.90	+ 0.07	−0.30	0.00
4	Geminorum	6.7	90 19 18.82	5024.25	0.24	−0 26 19.26	+45.66	− 1.14	−0.32	0.00
5	Geminorum	5.9	90 31 56.34	5020.23	+ 1.60	+0 59 24.50	+40.69	− 6.00	−0.32	0.00
68	Orionis	5.7	90 44 21.68	5025.90	+ 1.75	−3 38 17.28	+45.52	− 1.24	−0.19	0.00
6	Geminorum	6.3	90 44 32.68	5025.49	+ 1.01	−0 31 10.66	+45.47	− 1.29	−0.32	0.00
[illegible]	Aurigæ	4.4	91 16 22.13	5019.94	− 5.27	+6 5 43.07	+20.35	−26.36	−0.06	0.00
η	Geminorum	3.2	91 20 40.95	5019.12	− 5.31	0 54 25.22	+44.98	− 1.72	+0.10	0.00
71	Orionis	5.1	91 25 32.10	5015.55	− 8.50	−4 14 56.75	+27.11	−19.58	−0.13	0.00
8	Geminorum	6.1	91 38 0.23	5023.44	− 1.16	+0 33 52.50	+44.08	− 2.59	−0.30	0.00
9	Geminorum	6.2	91 47 25.90	5025.13	+ 0.56	+0 20 22.67	+45.84	− 0.80	−0.34	0.00
μ	Geminorum	3.2	93 12 18.59	5031.26	+ 0.79	−0 50 5.44	+35.23	−11.24	+0.10	0.00
16	Geminorum	6.2	94 27 24.55	5021.41	− 2.68	−2 48 13.91	+45.63	− 0.65	−0.34	0.00
	Geminorum	4.0	94 42 31.01	5023.43	0.61	−3 4 29.73	+44.62	− 1.62	0.00	0.00
21	Geminorum	7.2	95 37 42.93	5025.93	+ 2.35	−5 27 32.31	+49.65	+ 3.56	0.36	0.00
40	Aurigæ	5.1	95 41 41.57	5025.40	+ 0.03	+4 48 8.19	+43.41	− 2.67	−0.11	0.00
γ	Geminorum	1.9	97 0 32.74	5028.27	+ 5.04	−6 45 35.47	+41.30	4.54	+0.24	0.00
ε	Geminorum	3.2	97 50 40.20	5024.89	0.06	+2 3 6.06	+43.86	− 1.81	+0.10	0.00
26	Geminorum	5.2	98 2 55.52	5025.47	+ 2.07	−5 26 12.62	+36.48	9.14	0.13	−0.01
d	Geminorum	5.2	99 51 49.06	5025.04	+ 0.78	−1 9 43.05	+40.80	− 4.43	0.14	−0.01
ω	Geminorum	5.2	102 6 40.02	5024.48	− 0.45	+1 31 25.86	+44.65	0.03	−0.16	−0.01
ζ	Geminorum	3.8	102 53 47.43	5023.80	− 0.17	−2 3 25.77	+43.73	− 0.73	+0.02	0.00
47	Geminorum	5.6	103 49 15.69	5024.91	− 0.88	+4 22 52.64	+38.96	− 5.25	0.18	−0.02
48	Geminorum	5.8	104 23 37.70	5024.31	− 0.72	+1 42 13.22	+39.84	− 4.20	−0.22	−0.02
52	Geminorum	6.1	104 48 21.04	5031.44	+ 6.15	+2 31 12.69	+35.96	7.95	0.28	−0.02
δ	Geminorum	3.3	106 2 33.52	5023.32	− 1.15	−0 11 44.49	+41.79	1.62	+0.04	0.00
λ	Geminorum	3.7	106 41 13.55	5019.13	− 3.56	−5 39 4.75	+38.35	− 4.98	+0.05	0.00
56	Geminorum	5.2	107 3 39.06	5018.14	− 5.85	−1 39 37.22	+39.94	3.27	−0.12	−0.01
63	Geminorum	5.3	108 15 15.08	5021.09	− 3.28	0 28 13.92	+31.19	11.62	−0.16	−0.03
ι	Geminorum	4.3	109 14 59.65	5025.92	− 0.47	+5 12 10.77	+31.33	11.13	−0.02	0.00
176 B.	Geminorum	6.3	110 10 55.10	5031.20	+ 5.64	+2 46 57.39	+40.11	2.01	0.28	−0.04
67	Geminorum	6.7	110 28 37.07	5021.06	− 1.22	−6 0 22.29	+41.77	− 0.24	−0.32	−0.05
68	Geminorum	5.2	110 29 39.68	5021.71	− 0.64	−5 48 47.36	+39.48	− 2.53	−0.12	0.02
c	Geminorum	5.5	111 15 13.16	5024.47	− 1.76	+4 24 48.71	+38.56	− 3.16	0.16	−0.03
κ	Geminorum	3.6	111 34 18.80	5024.79	− 0.93	+3 3 49.51	+35.35	− 6.25	+0.05	+0.01
f	Geminorum	5.3	111 34 53.54	5022.78	− 0.29	−3 45 40.51	+41.98	+ 0.39	−0.14	−0.02
82	Geminorum	6.3	112 43 22.64	5023.94	− 1.39	+1 59 33.77	+40.78	− 0.36	−0.30	−0.04
g	Geminorum	5.0	112 59 52.72	5017.78	− 5.67	−2 39 43.72	+33.63	7.40	−0.13	−0.02
φ	Geminorum	4.9	113 9 0.49	5024.78	− 2.11	+5 45 49.32	+37.86	− 3.10	−0.11	−0.02
85	Geminorum	5.2	114 57 20.21	5023.44	− 0.71	−0 53 45.35	+35.71	− 4.51	−0.16	−0.03
ω	Cancri	6.1	115 3 44.02	5027.10	+ 0.52	+4 44 37.96	+39.83	− 0.31	−0.23	−0.04
4	Cancri	6.2	115 18 9.03	5024.76	− 1.72	+4 28 53.24	+40.41	+ 0.36	−0.26	−0.04
1	Cancri	6.0	116 3 37.95	5020.17	− 2.21	−4 51 2.39	+34.79	− 4.94	−0.23	−0.04
5	Cancri	5.9	116 59 34.19	5023.29	+ 0.57	−3 59 7.42	+39.38	+ 0.07	−0.29	−0.05
μ	Cancri	5.5	117 23 36.19	5029.43	+ 4.29	+1 20 17.55	+31.44	− 7.69	−0.16	−0.03
ζ	Cancri	4.6	119 14 40.91	5033.24	+ 9.81	−2 16 42.07	+27.22	−11.04	−0.12	−0.03
λ	Cancri	5.9	119 43 15.00	5025.81	− 0.85	+4 21 54.95	+34.98	− 3.05	−0.20	−0.04
φ¹	Cancri	5.7	121 40 51.50	5019.50	− 4.52	−1 1 2.82	+32.81	− 4.24	−0.23	−0.05
φ²	Cancri	6.2	122 33 32.78	5008.55	−14.88	−2 7 22.33	+17.35	−19.25	−0.26	−0.06
η	Cancri	5.6	123 18 51.88	5023.31	− 2.04	+1 33 31.53	+30.04	− 6.16	−0.18	−0.03
θ	Cancri	5.5	123 38 10.11	5020.31	− 3.81	−0 46 48.56	+28.10	− 7.94	−0.22	−0.05
29	Cancri	5.9	123 53 9.00	5020.16	− 1.86	−4 43 23.07	+33.22	− 2.68	−0.23	−0.05
38	Cancri	6.7	125 4 21.36	5023.56	− 1.70	+1 19 42.56	+34.69	− 0.58	−0.32	−0.07
39	Cancri	6.5	125 6 14.18	5022.13	− 3.26	+1 34 25.93	+32.76	− 2.49	−0.30	−0.07
98 B.	Cancri	6.6	125 9 49.21	5025.09	− 0.05	+1 6 23.88	+32.22	− 3.00	−0.31	−0.07
102 B.	Cancri	6.5	125 15 0.30	5018.87	− 6.35	+1 15 47.08	+32.47	− 2.71	−0.30	−0.07
ε	Cancri	6.3	125 18 1.88	5024.92	− 0.24	+1 8 40.89	+32.26	− 2.88	−0.28	−0.06
42	Cancri	6.7	125 19 1.89	5023.76	− 1.50	+1 19 55.18	+33.49	− 1.64	−0.32	−0.07

The above longitudes and latitudes include the magnitude equation.

Longitude and Latitude of Stars Occulted before 1862, Referred to the Equinox of 1850.0—Continued.

Name of Star.	Mag.	Longitude, 1850.	Centennial Variation.	Proper Motion.	Latitude, 1850.	Centennial Variation.	Proper Motion.	Mag. Eq.	
								ΔL.	ΔB.
		° ′ ″	″	″	° ′ ″	″	″	″	″
107 B. Canceri	6.7	125 24 9.75	5022.94	2.26	+1 12 39.11	+32.73	2.36	0.32	0.07
γ Canceri	4.7	125 26 50.14	5017.79	−8.50	+3 10 43.69	+28.37	6.69	0.05	0.02
δ Canceri	4.1	126 37 33.22	5020.53	+4.96	+0 4 20.92	+10.90	23.50	0.04	0.01
A² Canceri	5.7	128 45 6.92	5015.80	−5.44	−5 37 15.48	+25.83	7.35	0.[illegible]	−0.05
o¹ Canceri	5.1	130 17 13.27	5028.50	+3.08	−1 51 6.77	+35.07	+3.70	0.14	−0.04
o² Canceri	5.7	130 17 35.13	5028.91	+5.33	−1 34 51.71	+36.21	+3.94	−0.19	−0.05
68 Canceri	7.1	130 49 40.16	5022.31	−2.31	+0 8 23.82	+31.49	0.46	−0.42	−0.11
60 Canceri	5.7	131 0 34.63	5020.44	−0.75	−5 29 24.94	+29.66	2.17	−0.20	−0.05
α Canceri	4.3	131 32 4.[illegible]	5025.99	+4.58	−5 5 32.66	+28.49	3.03	−0.04	−0.01
κ Canceri	5.0	134 4 35.[illegible]	5019.57	−1.40	5 34 54.50	+28.18	−1.75	−0.12	−0.03
π Canceri	5.6	134 33 22.07	5021.12	−2.80	−0 57 35.71	+27.96	−1.67	−0.19	0.05
83 Canceri	6.6	134 34 54.13	5019.55	−6.23	+1 57 8.06	+13.38	−16.24	0.31	0.08
222 B. Canceri	6.3	136 12 12.14	5028.55	+6.67	−4 2 54.18	+29.91	+1.35	0.28	0.07
8 Leonis	5.9	139 4 40.23	5025.67	−0.29	+2 5 50.66	+24.98	−1.66	−0.23	0.07
ω Leonis	5.5	139 26 53.72	5026.43	+5.70	5 33 58.34	+26.99	+0.66	−0.19	0.06
ξ Leonis	5.0	139 33 22.68	5016.18	6.20	3 9 42.04	+15.47	10.88	−0.14	0.05
h Leonis pr.)	5.2	140 3 46.95	5021.89	+0.57	4 30 57.87	+14.78	1.19	−0.17	0.05
ψ Leonis	5.6	141 23 30.72	5024.80	+0.03	+0 20 24.68	+24.08	0.07	−0.20	0.06
ο Leonis	3.7	142 9 32.57	5009.57	12.31	−3 45 49.63	+16.82	7.69	+0.02	+0.01
18 Leonis	5.8	142 44 9.98	5022.33	+1.12	1 31 58.14	+24.61	+0.50	−0.25	0.07
ν Leonis	5.0	145 14 38.97	5021.57	−3.00	+0 2 36.04	+18.[illegible]	−3.98	0.16	0.05
η Leonis	3.6	145 48 34.33	5025.22	−2.86	+4 51 25.00	+20.40	1.50	+0.05	+0.02
83 B. Leonis	5.9	146 2 16.13	5011.08	10.96	3 24 24.28	+19.57	2.17	−0.24	0.07
π Leonis	5.0	147 13 15.50	5018.51	3.13	3 55 8.50	+16.89	3.07	0.12	0.04
α Leonis	1.4	147 44 40.27	5001.76	23.11	+0 27 35.94	+11.[illegible]	8.76	+0.31	+0.09
A Leonis	4.6	148 19 20.38	5017.95	5.52	1 25 26.30	+10.83	−9.22	−0.07	0.02
37 Leonis	5.5	149 0 10.23	5025.36	1.29	+2 40 22.71	+17.54	−2.00	0.13	0.08
14 Sextantis	6.3	149 36 29.69	5017.25	3.03	5 37 45.80	+17.74	−1.35	0.35	0.12
42 Leonis	6.1	149 43 10.82	5026.59	1.29	+4 26 14.91	+15.51	3.42	0.26	0.09
16 Sextantis	6.8	149 59 0.40	5020.51	0.32	4 53 27.30	+17.05	1.76	0.37	0.13
19 Sextantis	5.9	151 22 20.60	5014.95	4.07	6 1 48.10	+18.20	2.55	0.24	0.08
167 B. Leonis	7.1	151 31 37.90	5021.75	0.20	+4 27 58.52	+12.04	5.60	0.37	0.13
46 Leonis	5.8	152 22 4.51	5024.05	4.00	+4 34 32.40	+17.79	+0.80	0.[illegible]	0.07
ρ Leonis	3.8	154 17 41.42	5024.24	0.40	+0 8 37.48	+14.98	0.52	0.00	0.00
49 Leonis	5.7	155 2 59.81	5020.63	−3.70	−0 15 41.61	+12.35	−2.57	0.20	0.07
k Leonis	5.5	155 33 28.82	5019.56	9.03	+5 55 38.50	+3.75	10.77	0.20	0.07
48 Leonis	5.2	155 37 41.67	5011.37	11.71	−1 51 37.03	+14.83	+0.36	0.14	0.05
37 Sextantis	6.3	158 26 31.69	5023.52	+0.06	1 20 46.80	+7.91	4.33	0.26	0.10
34 Sextantis	6.6	158 41 53.77	5011.88	−9.20	−4 15 26.74	+11.32	0.72	0.44	0.17
ι Leonis	5.1	161 54 50.36	5020.47	3.89	−0 12 30.72	+5.16	4.31	0.13	0.05
χ Leonis	4.6	162 25 36.38	4995.12	30.50	+1 20 42.24	−8.05	17.11	−0.08	0.03
[illegible] Leonis	6.1	162 48 40.19	5030.64	+10.69	−5 38 51.25	+11.70	+[illegible]	−0.24	0.09
d Leonis	5.1	162 49 31.76	5023.92	+1.42	−2 31 12.78	+6.89	1.83	0.12	0.05
p¹ Leonis	5.6	164 56 44.33	4989.77	−31.96	−3 25 53.25	15.04	22.05	0.12	0.05
l Leonis	4.1	165 27 43.92	5040.88	+17.36	+6 6 9.94	+4.02	1.67	+0.01	+0.01
σ Leonis	4.[illegible]	166 36 51.36	5017.94	−7.98	+1 41 48.47	+0.87	4.78	0.01	0.00
p⁵ Leonis	5.3	167 18 26.57	5016.88	−3.85	−4 38 14.31	+3.10	1.98	0.10	−0.08
τ Leonis	5.2	169 25 0.50	5025.88	+1.80	−0 33 20.15	+2.33	1.02	0.1	−0.05
89 Leonis	5.7	170 49 1.07	5012.25	12.50	+0 16 20.40	14.45	16.65	−0.20	−0.08
ξ Virginis	4.8	171 14 10.71	5037.03	+7.45	+0 6 51.40	+1.40	0.46	0.11	0.04
ν Virginis	4.2	172 3 39.83	5033.76	+5.45	+4 35 36.30	16.70	17.94	0.0[illegible]	0.01
e Leonis	5.1	172 17 0.19	5022.67	+2.84	−5 42 12.42	+1.29	+0.29	0.13	0.05
υ Leonis	4.5	172 56 38.45	5020.41	−1.61	−3 2 40.16	+4.00	+3.55	0.06	0.02
β Virginis	3.8	175 2 12.32	5103.93	+78.83	+0 41 35.28	+2.93	+4.20	+0.04	+0.03
b Virginis	5.2	176 26 15.67	5026.58	−0.71	+3 21 0.03	3.98	1.[illegible]	−0.14	0.06
13 B. Virginis	5.9	177 58 48.01	5020.59	+0.82	−5 40 53.42	2.64	+1.04	−0.23	0.09
c Virginis	5.1	181 15 57.00	5004.24	−24.43	+5 4 19.19	−24.83	−18.46	−0.14	0.06
13 Virginis	5.9	182 30 1.45	5028.86	+3.41	+1 8 9.09	−8.18	0.80	−0.28	−0.11
η Virginis	4.0	182 44 21.55	5021.78	−3.86	+1 22 13.64	12.22	−4.65	−0.14	−0.06
γ Virginis (mean)	2.9	188 4 4.36	4976.18	−50.59	+2 48 15.46	−33.04	−21.18	+0.12	+0.05
q Virginis	5.3	189 23 41.03	5012.31	−7.99	−5 10 55.39	−15.94	3.03	0.[illegible]	−0.08
28 Virginis	7.2	190 29 3.96	5025.33	+2.96	−2 44 28.52	17.51	1.74	0.38	−0.16
k Virginis	5.7	193 6 44.05	5022.82	−3.54	+2 [illegible] 57.73	17.76	1.93	0.23	−0.09
48 Virginis	6.5	194 2 2.34	5023.23	3.54	+2 54 43.31	[illegible]	4.48	−0.30	−0.11
θ Virginis	4.4	196 8 35.51	5023.32	2.54	+1 45 9.13	[illegible]	5.37	0.05	−0.02

ΔL [illegible] tan B sin L [illegible] T; ΔB [illegible] L cos L [illegible]

Longitude and Latitude of Stars Occulted before 1862, Referred to the Equinox of 1850.0—Continued.

Name of Star.	Mag.	Longitude, 1850.	Centennial Variation.	Proper Motion.	Latitude, 1850.	Centennial Variation.	Proper Motion.	Mag. Eq.	
								ΔL.	ΔB.
		° ′ ″	″	″	° ′ ″	″	″	″	″
49 Virginis	5.2	197 39 3.38	5023.61	+ 1.53	−3 15 10.21	− 20.19	− 0.90	−0.14	−0.06
58 Virginis	7.2	199 45 27.36	5015.59	− 7.33	−2 10 59.83	− 23.32	− 2.46	−0.36	−0.14
l Virginis	4.8	201 29 47.12	5018.89	− 7.92	+3 8 5.94	− 30.07	− 7.94	−0.11	−0.04
α Virginis	1.2	201 44 55.61	5020.38	− 2.67	−2 2 35.29	− 26.89	− 4.57	+0.34	+0.04
80 Virginis	5.6	202 0 11.98	5026.26	− 1.35	+4 15 7.25	− 14.92	+ 7.58	−0.22	−0.08
i Virginis	5.7	202 40 24.76	5009.86	−12.27	−3 20 23.00	− 30.42	− 7.44	−0.18	−0.07
69 Virginis	4.9	204 3 20.19	5007.91	−12.13	−6 18 30.15	− 27.47	− 3.50	−0.11	−0.04
m Virginis	5.2	204 37 3.02	5014.43	−11.31	+1 43 14.95	− 25.29	− 0.92	−0.16	−0.05
75 Virginis	5.6	205 2 32.77	5013.88	− 6.95	−5 15 35.64	− 26.96	− 2.30	−0.20	−0.07
88 Virginis	6.5	205 29 43.52	5024.02	− 3.34	+4 3 23.68	− 29.80	− 4.82	−0.36	−0.14
85 Virginis	6.1	208 3 15.01	5018.76	− 2.69	−4 31 30.31	− 31.43	− 4.69	−0.25	−0.08
607 B. Virginis	6.8	210 23 47.16	5024.56	+ 1.28	−1 53 20.46	− 27.95	+ 0.36	−0.34	0.12
94 Virginis	6.6	210 23 54.42	5025.21	− 1.74	+3 40 42.77	− 28.01	+ 0.30	−0.34	0.12
95 Virginis	5.4	210 38 39.55	5012.66	−14.05	+3 19 9.25	− 32.44	− 3.98	−0.20	−0.07
κ Virginis	4.4	212 24 0.91	5022.72	− 3.69	+2 55 11.78	− 16.88	+ 12.73	−0.04	−0.01
40 H. Virginis	5.1	213 56 32.14	5023.54	+ 0.86	−2 55 22.46	− 13.77	− 1.19	−0.13	−0.05
λ Virginis	4.5	214 51 31.10	5020.83	− 4.01	+0 30 10.78	− 30.37	+ 0.78	−0.07	−0.02
μ Libræ	5.4	222 4 29.04	5019.12	− 6.52	+2 2 55.17	− 40.32	− 4.97	−0.17	−0.05
13 Libræ	5.7	222 35 53.64	5020.88	− 6.11	+4 33 38.64	− 39.57	− 3.94	−0.23	−0.07
8 Libræ	5.4	222 56 3.10	5016.87	− 7.86	+0 22 52.31	− 46.01	− 10.20	−0.17	−0.05
α Libræ	2.7	222 59 29.60	5016.26	− 8.45	+0 21 8.11	− 46.50	− 10.65	+0.12	+0.04
10 Libræ	6.8	223 53 14.88	5019.75	− 3.84	−1 47 46.80	− 36.66	− 0.34	−0.29	−0.08
ν Libræ	5.3	226 40 39.74	5021.32	− 3.81	+1 12 48.46	− 42.65	− 4.91	−0.17	−0.01
26 Libræ	6.3	228 54 37.02	5022.10	− 2.55	+0 15 55.20	− 41.24	− 2.42	−0.30	−0.08
ι Libræ	4.3	228 54 41.09	5022.58	− 2.81	−1 50 37.37	− 45.14	− 6.33	−0.11	−0.03
25 Libræ	6.0	229 7 23.44	5019.86	− 3.91	−1 37 24.26	− 43.67	− 4.76	−0.30	−0.08
ο Libræ	6.2	229 49 44.04	5027.79	+ 1.98	+2 48 29.77	− 36.18	+ 3.06	−0.24	0.06
28 Libræ	6.2	230 27 53.62	5024.14	− 0.51	+0 16 48.22	− 45.98	− 6.46	−0.24	0.06
ξ Libræ	5.6	232 55 22.24	5024.55	− 0.92	+2 15 2.25	− 44.20	− 3.61	−0.17	−0.04
γ Libræ	4.1	233 2 25.16	5032.87	+ 6.50	+4 24 7.50	− 38.35	+ 2.28	0.00	0.00
41 Libræ	5.3	234 52 33.04	5035.47	+10.86	+0 12 15.54	− 44.67	− 3.29	−0.20	−0.05
η Libræ	5.5	235 15 32.07	5023.96	− 2.13	+4 1 7.53	− 50.19	− 8.66	−0.18	−0.06
κ Libræ	5.0	235 39 48.58	5022.18	− 2.35	+0 0 10.63	− 53.16	− 11.48	−0.12	−0.02
42 Libræ	5.0	236 13 36.55	5021.13	− 1.84	−4 7 11.81	− 45.12	− 3.22	−0.12	0.03
θ Libræ	4.4	237 46 28.83	5032.45	+ 6.68	+3 29 0.12	− 28.84	+ 13.63	−0.04	−0.01
λ Libræ	4.9	238 22 54.76	5023.18	− 1.38	+0 6 15.92	− 47.72	− 5.03	−0.12	0.03
b Scorpii	4.7	239 1 53.85	5020.52	− 2.14	−5 28 5.87	− 47.89	− 4.99	−0.10	0.02
49 Libræ	5.4	239 17 16.41	4972.61	−53.27	+4 1 12.97	− 94.12	− 51.12	−0.19	0.04
A Scorpii	4.6	239 31 28.32	5021.10	− 1.78	−4 55 42.03	− 45.79	− 2.72	−0.08	0.02
δ Scorpii	2.7	240 28 38.38	5023.05	− 0.84	−1 58 0.23	− 47.11	− 3.72	+0.18	+0.04
π Scorpii	3.0	240 50 46.96	5022.50	− 0.29	−5 27 20.58	− 48.50	− 5.00	+0.11	+0.03
β Scorpii	2.9	241 5 43.83	5023.84	− 1.01	+1 1 37.24	− 46.64	− 3.06	+0.12	+0.03
ω¹ Scorpii	4.3	241 34 30.60	5023.31	− 1.29	+0 14 24.26	− 47.98	− 4.25	−0.01	0.00
ω² Scorpii	4.6	241 44 52.06	5029.82	+ 5.27	+0 4 14.92	− 48.91	− 5.13	−0.07	−0.02
ν Scorpii	3.9	242 32 57.63	5023.48	− 1.54	+1 39 10.52	− 48.46	− 4.43	−0.06	−0.02
65 B. Scorpii	5.5	242 55 57.12	5035.17	+12.17	−5 15 41.96	− 39.37	+ 4.77	−0.18	−0.04
83 B. Scorpii	6.7	243 17 19.15	5012.59	−11.89	−0 11 6.14	− 45.07	− 0.83	−0.32	0.04
58 G. Scorpii	6.2	244 19 59.95	5025.23	+ 0.38	+1 12 1.69	− 45.26	− 0.74	−0.26	−0.04
19 Scorpii	4.9	245 20 37.65	5022.51	− 1.34	−2 38 7.16	− 46.33	− 1.54	−0.08	−0.02
σ Scorpii	3.0	245 42 21.12	5022.69	− 0.82	−4 1 2.94	− 48.98	− 4.10	+0.12	+0.02
χ Ophiuchi	4.9	245 53 4.53	5024.79	− 0.55	+3 14 36.70	− 47.26	− 2.32	−0.12	−0.02
ρ Ophiuchi	4.7	246 20 34.82	5022.24	− 1.87	−1 44 13.45	− 46.12	− 1.08	−0.08	−0.02
22 Scorpii	4.8	247 38 41.64	5023.58	− 0.22	−3 13 15.97	− 47.05	− 1.70	−0.07	−0.01
α Scorpii	1.3	247 40 6.65	5023.15	− 0.36	−4 32 59.92	− 48.29	− 2.94	+0.35	+0.04
24 Scorpii	5.0	249 12 33.04	5023.02	− 2.41	+4 27 10.34	− 46.43	− 0.74	−0.12	−0.02
τ Scorpii	2.8	249 21 47.80	5022.12	− 1.18	−6 6 0.86	− 49.37	− 3.65	+0.13	+0.02
18 Ophiuchi	6.8	251 58 24.19	5024.35	+ 0.17	−2 8 50.26	− 50.33	− 4.13	−0.32	−0.05
24 Ophiuchi	5.5	253 24 23.82	5025.06	+ 0.60	−0 28 58.32	− 49.81	− 3.40	−0.19	−0.02
29 Ophiuchi	6.4	254 8 12.06	5021.85	− 3.20	+3 52 54.97	− 48.02	− 2.40	−0.30	−0.02
36 Ophiuchi	5.4	257 56 2.41	4984.87	−39.38	−3 28 50.94	−167.62	−120.71	−0.17	−0.02
157 B. Ophiuchi	6.7	258 20 57.38	5034.34	+ 9.88	−0 57 28.25	− 53.10	− 6.16	−0.29	−0.02
θ Ophiuchi	3.3	259 18 1.94	5023.82	− 0.60	−1 49 22.33	− 50.64	− 3.63	+0.07	+0.01
43 Ophiuchi	5.4	259 48 20.03	5024.30	+ 0.03	−4 56 23.63	− 51.02	− 3.98	−0.19	−0.02
191 B. Ophiuchi	6.3	259 57 14.12	5025.69	+ 1.21	−1 1 32.80	− 45.29	+ 1.76	−0.28	−0.02
44 Ophiuchi	4.1	260 14 19.66	5024.12	− 0.38	−0 56 5.50	− 60.84	− 13.78	−0.06	0.00

The above longitudes and latitudes include the magnitude equation

Longitude and Latitude of Stars Occulted before 1862, Referred to the Equinox of 1850.0—Continued.

Name of Star.	Mag.	Longitude, 1850.	Centennial Variation.	Proper Motion.	Latitude 1850.	Centennial Variation.	Proper Motion.	Mag. Eq. ΔL.	ΔB.
		° ′ ″	″	″	° ′ ″	″	″	″	″
52 Ophiuchi	6.4	262 11 2.98	5023.60	− 0.95	+1 17 35.21	−47.59	− 0.46	−0.30	−0.02
58 Ophiuchi	4.8	264 3 31.32	5016.04	− 8.47	+1 43 20.67	−52.70	− 5.56	−0.10	0.00
X Sagittarii	4.4–5.4	265 8 50.94	5024.96	+ 0.33	−4 24 4.22	−48.65	− 1.53	−0.08	0.00
W Sagittarii	4.3–5.1	269 0 10.37	5025.97	+ 0.95	−6 7 32.67	−48.45	− 1.52	+0.16	0.00
μ Sagittarii	4.0	271 7 8.75	5023.67	− 0.60	+2 21 41.35	−46.87	− 0.15	−0.01	0.00
16 Sagittarii	5.9	271 28 33.45	5024.86	+ 0.67	+3 1 24.99	−46.86	− 0.17	−0.26	0.00
66 B. Sagittarii	4.7	271 55 56.52	5024.95	− 0.02	[illegible] 38 49.05	−45.14	+ 1.49	−0.08	0.00
67 B. Sagittarii	6.4	272 7 23.20	5018.64	− 6.16	[illegible] 12 46.93	−52.66	− 6.05	−0.29	0.00
δ Sagittarii	2.9	272 29 4.90	5028.30	+ 2.94	6 27 6.16	50.02	− 3.46	+0.14	0.00
21 Sagittarii	5.0	273 50 44.21	5024.07	− 0.05	[illegible] 47 14.81	−48.77	− 2.39	−0.12	0.00
λ Sagittarii	2.9	274 13 28.85	5019.55	− 5.30	[illegible] 6 31.38	−66.01	−10.60	+0.11	0.00
24 Sagittarii	5.7	275 38 23.99	5024.23	− 0.44	0 48 2.46	−48.06	− 1.07	−0.23	0.00
110 B. Sagittarii	7.2	276 16 25.53	5025.81	+ 2.00	+3 56 1.45	−48.22	− 2.25	−0.38	0.00
121 B. Sagittarii	5.9	276 58 59.71	5015.56	− 8.57	+2 6 24.27	−59.19	−13.34	−0.23	0.00
φ Sagittarii	3.3	278 5 3.52	5029.86	+ 4.51	3 56 5.41	−46.56	− 0.04	+0.08	−0.01
28 Sagittarii	5.6	278 36 23.61	5026.95	+ 2.56	+0 38 11.02	−44.73	+ 0.78	−0.19	+0.02
29 Sagittarii	5.3	279 33 2.43	5024.86	+ 0.93	+2 37 53.22	−42.33	+ 2.07	−0.18	+0.01
σ Sagittarii	2.1	280 17 24.73	5024.28	− 1.06	−3 25 41.06	−52.55	− 7.42	+0.20	−0.02
33 Sagittarii	5.8	280 28 2.02	5022.96	− 1.21	+1 30 43.00	−46.49	− 1.40	−0.24	+0.02
ξ Sagittarii	3.7	281 21 10.47	5027.05	+ 2.95	+1 40 50.27	−47.41	− 2.54	+0.06	0.00
τ Sagittarii	3.5	282 44 33.79	5017.14	− 8.77	−5 3 37.10	−60.10	4.00	+0.06	0.00
ο Sagittarii	3.9	282 53 48.10	5030.62	+ 6.53	+0 52 52.56	−51.48	7.02	+0.01	0.00
187 B. Sagittarii	6.4	283 48 42.86	5027.93	+ 4.48	+3 47 54.20	50.29	− 6.08	−0.29	+0.02
π Sagittarii	3.0	284 9 27.86	5022.99	− 1.12	+1 27 24.66	−47.59	− 3.40	+0.11	−0.02
d Sagittarii	5.1	286 15 18.36	5021.18	− 2.30	+3 16 37.63	−44.86	− 1.39	−0.11	+0.01
234 B. Sagittarii	5.9	286 34 58.37	5024.90	− 1.50	−5 46 4.[illegible]	−41.45	+ 1.91	−0.23	+0.02
236 B. Sagittarii	6.4	287 8 59.57	5023.93	+ 0.35	+2 52 13.22	42.28	[illegible]	−0.30	+0.02
χ Sagittarii	4.9	287 14 22.73	5029.01	+ 3.66	−2 28 6.80	50.00	6.85	−0.13	+0.02
45 Sagittarii	6.0	287 19 46.15	5031.22	+ 7.05	+3 47 1.87	52.4[illegible]	[illegible]	−0.24	+0.03
ρ Sagittarii	4.0	287 21 25.73	5020.46	− 2.66	+4 14 27.22	41.[illegible]	[illegible]	+0.01	0.00
49 Sagittarii	5.5	287 22 15.63	5022.95	2.23	1 56 10.14	42.66	+ 0.45	−0.18	+0.02
50 Sagittarii	5.5	287 52 31.65	5027.05	+ 2.58	+0 11 40.16	43.17	0.24	0.18	+0.02
h Sagittarii	4.7	289 44 58.65	5031.28	+ 5.57	−3 14 25.94	45.87	3.60	0.05	+0.01
c Sagittarii	5.2	292 33 46.98	5027.99	+ 5.53	+5 9 57.78	43.64	2.45	−0.1[illegible]	+0.02
f Sagittarii	5.1	292 50 0.27	5008.70	−15.26	+1 25 36.72	47.42	− 6.32	−0.13	+0.02
ω Sagittarii	4.8	293 44 46.76	5047.50	+20.72	5 24 24.04	36.47	+ 4.25	−0.12	+0.02
57 Sagittarii	6.0	294 18 46.03	5022.88	− 0.86	+1 52 44.11	−46.10	5.61	0.26	+0.04
A Sagittarii	4.9	294 27 42.92	5029.21	+ 2.37	5 26 27.98	37.17	+ 3.25	0.12	+0.02
σ Capricorni	5.5	300 34 57.80	5023.91	− 0.39	+0 28 15.36	38.14	0.53	0.19	+0.04
16 B. Capricorni	6.2	301 53 45.77	5025.74	+ 3.58	+4 36 50.32	37.31	0.36	0.23	+0.05
β Capricorni	3.2	301 57 7.87	5026.6[illegible]	+ 4.45	+4 36 15.08	37.26	[illegible]	+0.07	−0.0[illegible]
π Capricorni	5.1	302 37 11.26	5024.50	+ 0.44	+0 54 54.68	36.93	[illegible]	0.14	+0.03
ρ Capricorni	5.0	303 4 18.69	5021.65	− 2.24	+1 12 50.43	−37.85	[illegible]	0.12	+0.03
υ Capricorni	5.3	305 34 7.00	5021.80	− 2.60	+0 14 16.73	35.01	[illegible]	0.16	+0.05
17 Capricorni	5.8	306 4 41.57	5027.60	+ 1.17	−3 23 41.07	36.43	[illegible]	−0.22	+0.07
19 Capricorni	5.7	309 0 27.04	5018.80	− 6.02	−0 29 8.60	32.09	+ 0.35	0.24	+0.06
20 Capricorni	6.2	309 47 23.80	5026.70	+ 1.05	−1 52 13.03	34.98	[illegible]	0.26	+0.07
21 Capricorni	6.5	310 30 10.80	5021.32	3.52	0 30 42.04	31.37	[illegible]	[illegible]	+0.07
η Capricorni	4.8	310 38 43.20	5021.57	4.76	−2 58 30.06	[illegible]	3.47	[illegible]	0.04
χ Capricorni	5.3	311 11 15.34	5027.31	+ 0.01	−4 32 22.07	37.03	[illegible]	[illegible]	+0.04
θ Capricorni	4.1	311 44 48.46	5020.94	+ 5.05	−0 34 10.50	−30.81	8.4[illegible]	0.04	0.01
φ Capricorni	5.3	312 55 48.81	5027.31	− 0.05	4 30 52.50	−30.69	[illegible]	0.18	+0.04
ν Aquarii	4.4	314 17 50.76	5029.34	+ 7.86	+4 46 43.30	−32.77	[illegible]	0.07	+0.01
29 Capricorni	5.5	314 36 12.83	5026.36	+ 2.28	+0 42 15.05	−29.86	− [illegible]	0.18	+0.04
33 Capricorni	5.3	314 46 34.65	5022.76	− 5.19	−5 18 37.93	30.58	− 0.10	0.10	+0.05
35 Capricorni	6.0	315 21 17.62	5025.32	− 3.02	−5 52 2.82	31.33	[illegible]	0.24	0.06
ι Capricorni	4.3	315 35 9.59	5028.55	+ 3.14	−1 21 16.95	29.58	0.62	0.05	+0.02
18 Aquarii	5.5	317 15 6.80	5030.73	+ 7.70	+2 15 50.85	29.61	− 1.74	−0.17	+0.04
ε Capricorni	4.7	318 6 9.64	5027.89	+ 0.02	4 57 53.17	27.35	+ 0.05	−0.06	+0.0[illegible]
73 B. Aquarii	6.8	318 18 34.85	5025.72	+ 1.48	+0 25 45.03	31.08	− 3.02	−0.13	+0.10
143 B. Capricorni	6.1	319 25 21.87	5036.01	+ 7.66	5 35 1.26	33.18	− 3.77	−0.25	+0.07
κ Capricorni	4.8	319 32 37.26	5040.22	+12.39	4 40 36.00	31.18	− 4.85	−0.08	+0.03
γ Capricorni	3.7	319 41 18.48	5043.21	+16.04	2 32 35.18	−33.82	− 7.50	+0.01	0.01
44 Capricorni	6.0	321 6 59.22	5025.07	+ 0.00	0 38 43.36	22.74	+ 2.50	−0.12	+0.06
45 Capricorni	5.8	321 13 3.07	5023.42	+ 1.84	−1 3 1.61	24.74	+ 0.44	0.16	+0.06

$\Delta L = +0''.11 + 0''.0 \tan B \sin (L + 16°) F$; $\Delta B = +0''.0 F \cos (L + 16°)$

Longitude and Latitude of Stars Occulted before 1862, Referred to the Equinox of 1850.0—Continued.

Name of Star	Mag.	Longitude, 1850.	Centennial Variation.	Proper Motion.	Latitude, 1850.	Centennial Variation.	Proper Motion.	Mag. Eq. ΔL.	Mag. Eq. ΔB.
		° ′ ″	″	″	° ′ ″	″	″	″	″
δ Capricorni	2.9	321 26 28.24	5040.46	+14.12	−2 34 34.32	−61.40	−36.39	+0.12	−0.04
c¹ Capricorni	5.3	323 19 13.02	5022.30	+0.77	+4 13 6.46	−23.14	+0.56	−0.14	+0.05
c² Capricorni	6.3	323 33 3.75	5022.92	+1.20	+3 55 54.14	23.84	0.31	−0.26	+0.05
20 Aquarii (mean)	6.5	324 38 15.05	5029.20	+1.32	−4 38 9.44	−22.27	+0.48	−0.30	+0.09
ι Aquarii	4.4	326 37 26.68	5026.90	+0.85	−2 4 10.11	−28.20	−6.90	−0.04	+0.01
e Aquarii	5.4	328 23 27.40	5028.03	+3.29	0 16 28.18	−19.10	+0.90	−0.17	+0.06
40 Aquarii	7.1	328 54 26.96	5025.93	+0.76	−0 51 20.29	−21.39	−1.77	−0.37	+0.13
42 Aquarii	5.5	329 21 5.11	5027.78	+1.75	1 59 44.55	−18.99	+0.29	−0.20	+0.07
50 Aquarii	5.9	330 50 5.72	5032.16	+5.11	−3 19 9.70	−18.75	−0.59	−0.24	+0.08
θ Aquarii	4.3	331 9 16.15	5032.02	+9.55	+2 43 0.16	−23.52	−5.61	−0.04	+0.01
ρ Aquarii	5.3	331 56 2.18	5023.57	+0.86	+2 22 44.31	−18.56	−1.24	−0.17	+0.06
σ Aquarii	4.8	333 17 36.84	5024.50	−0.97	−1 13 13.16	−18.64	−2.36	0.10	+0.04
58 Aquarii	6.4	333 26 41.26	5031.33	+5.62	−1 31 20.09	−21.76	−5.60	−0.29	+0.10
51 Aquarii	5.8	333 55 39.98	5021.89	+1.09	+4 48 23.95	−17.40	−1.61	−0.22	+0.07
69 Aquarii	5.6	335 53 48.74	5031.89	+2.70	−5 54 47.58	16.85	−2.60	−0.19	+0.06
204 B. Aquarii	6.8	335 56 39.66	5042.97	+17.76	−0 51 47.23	17.92	−3.70	−0.34	+0.12
τ Aquarii	4.4	336 30 1.82	5026.67	−2.33	−5 39 28.04	16.38	−2.60	−0.01	0.00
κ Aquarii	5.2	337 19 39.61	5010.30	−10.97	+4 7 8.76	20.89	−7.76	−0.18	+0.06
70 Aquarii	6.1	337 27 17.98	5031.79	+5.09	−2 44 34.09	14.04	−1.01	−0.28	+0.09
λ Aquarii	3.8	339 28 50.14	5026.42	+1.58	−0 23 0.06	8.26	+3.16	+0.02	−0.01
78 Aquarii	6.3	340 4 24.53	5021.29	−3.42	−0 13 9.35	−12.67	−1.73	−0.28	+0.10
82 Aquarii	6.4	342 8 34.12	5023.62	−1.23	−0 23 47.64	−12.40	−3.12	0.34	+0.13
h Aquarii	5.4	342 18 14.68	5037.58	+11.69	1 40 48.12	12.25	−3.10	0.18	+0.07
ψ¹ Aquarii	4.5	344 11 56.30	5061.64	+33.86	−3 59 31.32	22.50	−14.88	0.06	+0.02
ψ² Aquarii	4.6	344 37 59.21	5029.54	+1.52	−4 16 47.28	8.14	−0.88	0.06	+0.02
ψ³ Aquarii	5.2	344 42 14.23	5032.05	+3.63	−4 46 33.95	8.85	−1.65	−0.13	+0.06
χ Aquarii	5.3	344 57 57.74	5024.25	−2.59	−2 50 18.77	7.44	−0.45	0.14	+0.07
φ Aquarii	4.6	345 2 44.04	5019.89	−5.48	1 2 29.92	25.71	18.76	−0.02	+0.01
96 Aquarii	5.7	346 33 38.70	5042.24	+17.15	−0 41 19.58	14.00	8.31	0.20	+0.11
337 B. Aquarii	6.4	349 7 9.19	5033.51	+8.05	−1 7 48.64	−30.74	−27.13	0.29	+0.12
κ Piscium	4.9	350 48 32.14	5024.91	+4.03	+4 26 17.94	14.00	−11.80	0.12	+0.05
9 Piscium	6.4	350 49 44.28	5024.32	+3.31	+4 16 55.58	6.79	−4.60	0.29	+0.12
15 Piscium	6.6	352 47 50.76	5043.72	+22.19	+3 38 32.46	13.81	−13.24	0.38	+0.16
16 Piscium	5.7	353 19 33.08	5013.10	−7.91	+4 16 13.67	+9.47	+9.61	0.19	+0.08
B. D.−1° 4485	7.3	354 12 8.65	5023.80		+0 53 2.86	+0.58	.	0.40	+0.16
λ Piscium	4.6	354 30 8.96	5002.97	−18.75	+3 25 14.61	7.84	−8.67	0.08	+0.03
21 Piscium	5.6	355 54 59.22	5021.76	−1.10	+2 2 7.85	1.15	−3.14	0.25	+0.10
30 Piscium	4.7	355 57 6.15	5031.79	+2.55	−5 42 35.10	3.16	−5.18	−0.07	+0.03
19 Piscium	5.4	356 10 32.27	5015.31	−5.47	+4 33 3.67	+2.42	+0.22	0.14	+0.06
27 Piscium	5.1	356 11 14.82	5019.79	−7.31	−3 7 46.42	1.79	4.00	−0.12	+0.05
33 Piscium	4.8	356 50 53.43	5032.16	+2.88	−5 46 14.28	+11.40	8.65	−0.07	+0.03
29 Piscium	5.1	357 7 1.66	5027.72	+0.76	−2 57 34.66	+1.38	1.60	−0.13	+0.05
22 Piscium	5.8	357 13 47.27	5022.51	+0.85	+3 29 12.40	1.53	−1.54	0.23	+0.09
4 Ceti	6.3	358 39 47.77	5029.84	+2.76	3 6 32.46	+4.01	0.24	0.29	+0.12
5 Ceti	6.3	358 48 41.28	5027.09	+0.94	3 3 46.53	5.43	1.07	−0.28	+0.11

The above longitudes and latitudes include the magnitude equation.

CHAPTER VII.

TABLE OF THE POSITION ANGLES USED IN COMPUTING THE COEFFICIENTS OF THE EQUATIONS OF CONDITION.

The circumstances under which the present work has been completed prevent all the required data and numbers from being collected on a uniform plan. It is believed, however, that incomplete lists of the numbers will be useful in any revision of the work that may be hereafter undertaken. The data will at least be harmless.

The arrangement of the original work was that adopted in the Researches of 1878. Instead of the occultations being worked up in chronological order the more convenient plan was adopted of working up each series made in any one place by itself. The principal numbers entering into the computations of the parallax and their corrections were tabulated in the form of tabular exhibits of the equations. Afterwards the equations themselves were formed and arranged in chronological order.

For reasons which will be mentioned in the next chapter these tabular exhibits have been omitted in publishing the present work, and instead of them are given merely the most needful data for the coefficients of the conditional equations.

The following are the tabular numbers retained in the present connection. They are all so clear that no detailed explanation seems necessary.

ALTONA.

Date.	Star.	m	m_1	m'	Date.	Star.	m	m_1	m'
1871, Nov. 18	ι Capricor.	225	207	223					

BERLIN.

Date.	Star.	m	m_1	m'	Date.	Star.	m	m_1	m'
1826, May 12	1 Cancri	226	236	222	1837, Feb. 17	λ Cancri	348	359	349
13	λ² Cancri	272	286	270	Mar. 12	62 Tauri	228	219	232
July 27	53 Arietis	307	292	302	July 9	η Virginis	99	122	95
Sept. 21	43 Tauri	66	55	61	Aug. 18	10 Ceti	263	240	268
1828, Mar. 24	68 Geminor.	263	271	262	18	10 Ceti	75	52	80
24	67 Geminor.	310	318	308	Oct. 9	143 B. Capricor.	254	237	256
1830, Mar. 3	26 Geminor.	233	236	234	9	143 B. Capricor.	88	105	91
29	111 Tauri	98	94	98	Nov. 5	35 Capricor.	316	300	318
	117 Tauri	300	296	301	1838, July 31	65 B. Scorpii	287	297	291
Apr. 28	1 Cancri	297	307	300	Sept. 8	ζ Arietis	255	240	250
Sept. 5	ι Piscium	313	292	310	Oct. 25	A Sagittarii	193	184	195
8	Piscium	40	28	46	Nov. 3	γ Tauri	213	203	216
Oct. 20	24 Scorpii	229	220	221	Dec. 26	27 Arietis	232	214	236
30	Piscium	322	301	310	1839, May 2	β Sagittarii	[illegible]	57	57
1831, Jan. 20	ι Piscium	280	280	270	Sept. 26	66 Arietis	18	5	20
1	ι Ceti	306	288	308	29	20 Tauri	317	305	318
8	18 Leonis	287	306	292	Oct. 18	58 Aquarii	241	220	246
Apr. 18	α Tauri	242	233	243	1840, Jan. 11	δ Piscium	278	255	28[illegible]
Dec. 17	γ Tauri	276	266	278	11	ζ Piscium	55	32	59
1832, Feb. 18	δ Leonis	231	240	236	13	ε Arietis	305	288	307
1	Leonis	267	286	275	13	ε Arietis	45	28	47
Apr. 14	80 Virginis	255	276	257	14	φ Tauri	302	290	303
1833, Dec. 26	η Geminor.	214	215	209	14	18 Tauri	231	219	232
1834, Aug. 12	β Scorpii	311	322	306	14	q Tauri	57	45	58
12	[illegible] Scorpii	61	74	68	16	400 B. Tauri	241	230	240
Oct. 7	44 Ophiuchi	266	272	[illegible]	16	130 Tauri	347	345	345
8	Sagittarii	264	262	258	16	136 Tauri	11	9	9
1835, Apr. 25	ε Leonis	218	237	218	Mar. 15	ι Leonis	258	277	253
8	[illegible]	161	180	161	15	α Leonis	126	143	120
May 27	118 Tauri	327	323	331	Apr. 11	ν Leonis	124	143	116

BERLIN—Continued.

Date.	Star.	m	m₁	m′
		°	°	°
1840, Apr. 16	85 Virginis	249	269	246
May 8	ψ Leonis	273	291	269
1841, Feb. 7	d Leonis	118	140	114
May 23	ω Geminor.	294	299	289
Aug. 10	17 Tauri	270	258	268
10	16 Tauri	230	218	228
10	20 Tauri	227	215	226
10	16 Tauri	123	111	121
10	17 Tauri	83	71	81
10	η Tauri	313	301	311
10	20 Tauri	124	112	123
10	η Tauri	37	25	35
1843, Oct. 6	19 Piscium	241	218	241
Nov. 27	c^2 Capricor.	289	271	291
1845, Mar. 22	e Leonis	334	311	336
May 16	e Leonis	322	345	324
16	e Leonis	48	71	50
20	48 Libræ	298	313	303
June 16	10 Libræ	215	231	220
Oct. 20	71 Orionis	255	255	252
20	71 Orionis	106	106	103
Nov. 6	ν Aquarii	204	188	204
6	ν Aquarii	142	126	142
9	22 Piscium	257	234	254
9	22 Piscium	100	77	96
1846, Aug. 14	68 Tauri	52	42	47
Sept. 14	68 Geminor.	78	86	77
Nov. 22	ρ Sagittarii	280	273	281
1876, Oct. 6	17 Tauri	245	232	248
6	17 Tauri	95	82	98
6	16 Tauri	197	184	199
6	16 Tauri	142	129	145
6	23 Tauri	311	298	314
6	23 Tauri	30	17	32
6	20 Tauri	204	191	206
6	η Tauri	298	285	301
6	24 Tauri	292	279	295
6	Anon. 24	259	246	262
6	20 Tauri	135	122	137
6	η Tauri	42	29	44
1879, Oct. 24	θ Aquarii	256	237	260
1880, Sept. 11	θ Ophiuchi	190	195	195
1881, Jan. 5	19 Piscium	340	317	340
May 11	75 Virginis	325	347	328
1884, Apr. 30	B. D. +15° 1619	280	289	280
30	B. D. +15° 1620	206	215	206
30	B. D. +15° 1624	263	273	263
30	B. D. +15° 1633	258	267	258
30	B. D. +15° 1635	297	307	297
30	B. D. +15° 1642	241	251	241
May 2	ω Leonis	302	320	304
8	λ Virginis	225	245	230
29	B. D. +10° 1956	261	278	263
June 28	B. D. + 0° 2793	284	307	288
July 15	o Piscium	71	50	66
30	88 B. Libræ	307	323	311
Sept. 8	B. D. + 9° 264	83	63	78
12	B. D. +17° 1101	97	96	95
12	B. D. +17° 1113	119	119	118
12	B. D. +17° 1136	13	13	12
12	B. D. +17° 1144	118	118	116
12	B. D. +17° 1145	150	150	148
12	B. D. +17° 1147	90	90	89
12	B. D. +17° 1151	85	85	84
12	B. D. +17° 1158	99	100	98
12	B. D. +17° 1161	97	97	96
12	124 H¹. Orionis	133	132	131
13	B. D. +16° 1380	110	116	110
13	B. D. +17° 1495	144	150	144
13	B. D. +16° 1385	99	105	99
1884, Sept. 13	B. D. +17° 1502	150	156	149
13	B. D. +16° 1395	93	99	93
13	B. D. +16° 1398	64	70	64
13	B. D. +16° 1400	78	85	78
14	B. D. +14° 1822	32	44	33
14	B. D. +14° 1825	62	73	63
14	B. D. +14° 1828	73	85	74
14	B. D. +14° 1829	74	85	75
14	B. D. +14° 1838	59	71	60
14	B. D. +14° 1839	126	138	127
15	B. D. +11° 1974	27	44	30
26	290 B. Ophiuchi	238	240	240
28	B. D. −17° 5672	291	282	290
28	B. D. −17° 5699	268	259	267
Oct. 30	11 Piscium	260	237	255
Nov. 22	B. D. −17° 5748	338	329	337
1885, Jan. 20	B. D. − 3° 5639	282	259	277
20	B. D. − 3° 5642	265	242	261
20	B. D. − 3° 5643	264	241	259
20	B. D. − 3° 5644	319	296	314
21	98 B. Piscium	264	241	259
22	ε Piscium	286	264	281
23	B. D. + 8° 307	297	278	293
23	B. D. + 8° 314	287	266	282
23	B. D. + 9° 264	218	197	213
23	B. D. + 9° 266	238	217	233
24	B. D. +12° 411	269	252	265
24	B. D. +12° 410	209	192	205
25	B. D. +15° 546	272	260	269
25	B. D. +15° 547	288	275	285
25	B. D. +15° 557	314	301	310
26	318 B. Tauri	334	328	332
Feb. 1	d Leonis	86	108	90
21	B. D. +14° 592	14	0	10
21	B. D. +14° 595	291	277	288
21	B. D. +14° 597	288	275	285
21	B. D. +14° 598	322	308	319
21	B. D. +14° 600	272	258	268
22	σ Tauri	340	331	337
22	σ Tauri	22	13	20
24	B. D. +17° 1339	239	242	239
24	B. D. +17° 1392	273	277	273
24	B. D. +17° 1393	315	319	315
Mar. 21	B. D. +15° 630	301	291	298
21	75 Tauri	288	278	286
21	B. D. +15° 633	348	338	346
21	264 B. Tauri	338	328	335
22	B. D. +17° 918	240	235	238
22	B. D. +17° 919	295	291	294
22	111 Tauri	295	291	294
22	B. D. +17° 921	233	229	232
22	B. D. +17° 929	318	314	317
22	117 Tauri	326	322	324
22	B. D. +17° 943	294	291	293
22	B. D. +17° 945	247	243	246
22	B. D. +17° 950	256	252	255
23	B. D. +17° 1225	289	290	289
23	B. D. +17° 1226	229	230	229
23	B. D. +17° 1230	308	309	308
23	B. D. +17° 1231	308	310	308
23	B. D. +17° 1238	297	299	297
23	B. D. +17° 1241	321	323	321
23	B. D. +17° 1247	257	259	257
23	B. D. +17° 1252	274	276	274
23	B. D. +17° 1256	290	292	290
23	B. D. +17° 1261	228	230	228
23	B. D. +17° 1263	327	329	327
23	B. D. +17° 1277	229	231	229
23	B. D. +17° 1280	292	294	292
23	B. D. +17° 1281	303	306	304

BERLIN Continued.

Date.	Star.	m	m₁	m′
		°	°	°
1885, Mar. 23	B. D. +17° 1288	308	311	308
23	B. D. +17° 1291	327	330	328
23	B. D. +17° 1294	298	301	298
23	B. D. +17° 1307	248	250	248
Apr. 18	B. D. +17° 862	233	228	232
19	B. D. +17° 1136	305	305	305
19	B. D. +17° 1139	309	309	309
19	B. D. +17° 1146	259	259	259
19	B. D. +17° 1147	230	230	230
19	B. D. +17° 1151	233	233	233
19	B. D. +17° 1153	329	329	329
19	B. D. +17° 1154	297	298	297
19	B. D. +17° 1154	297	298	297
19	B. D. +17° 1155	293	293	292
19	B. D. +17° 1167	262	263	262
19	B. D. +17° 1172	296	296	296
19	B. D. +17° 1177	250	251	250
19	B. D. +17° 1179	282	282	281
19	B. D. +17° 1183	272	273	272
19	B. D. +17° 1191	316	316	315
20	B. D. +17° 1506	215	221	216
20	B. D. +16° 1400	293	299	294
20	B. D. +16° 1419	241	248	242
20	B. D. +16° 1421	245	252	246
20	B. D. +16° 1423	226	232	227
21	30 B. Cancri	238	250	240
22	209 B. Cancri	226	242	229
26	71 G. Virginis	235	258	240
May 19	B. D. +12° 1931	294	309	297
19	B. D. +12° 1942	219	235	223
19	α Cancri	322	338	325
July 6	B. D. + 9° 296	112	93	108
6	B. D. + 9° 301	97	78	93
7	B. D. +12° 453	77	62	74
9	α Tauri	307	298	305
21	B. D. −16° 4230	257	268	259
12	29 Ophiuchi	352	359	354
Aug 31	B. D. +13° 565	74	59	71
31	B. D. +13° 568	86	72	84
Sept. 1	θ¹ Tauri	98	89	97
1	θ² Tauri	78	68	76
	B. D. +15° 633	144	135	143
1	B. D. +15° 635	130	121	129
1	260 B. Tauri	116	106	114
1	85 Tauri	33	24	32
1	B. D. +15° 646	62	52	60
1	B. D. +15° 648	42	33	41
1	B. D. +15° 649	40	30	38
1	275 B. Tauri	122	113	121
1	α Tauri	208	199	207
	B. D. +15° 653	145	136	143
	α Tauri	61	52	60
2	[illegible]	100	96	100
2	[illegible]	40	36	40
2	B. D. +17° 948	111	109	112
	B. D. +17° 942	49	45	48
	167 B¹ Tauri	[illegible]	10	23
	[illegible]	[illegible]	90	93
	[illegible]	[illegible]	142	145
	[illegible]	[illegible]	113	116
	[illegible]	[illegible]	[illegible]	48
	B. D. +14° [illegible]	140	140	139
5	B. D. +14° 1929	80	95	84
5	B. D. +14° 1930	79	93	82
16	B. D. −18° 4789	264	264	264
17	B. D. −18° 5134	306	301	304
17	B. D. −18° 5136	316	311	314
17	B. D. −18° 5155	298	292	296
17	B. D. −18° 5157	270	265	268
20	18 Aquarii	309	292	305
1885, Sept. 30	B. D. +17° 1195	71	72	72
30	292 B. Orionis	138	139	139
30	B. D. +17° 1223	153	154	154
30	B. D. +17° 1224	91	93	92
30	B. D. +17° 1226	109	110	110
Oct. 14	B. D. −18° 5012	246	243	245
16	B. D. −16° 5545	278	266	275
1894, Oct. 11	B. D. − 8° 6040	253	240	248
19	B. D. +28° 1095	94	96	94
19	B. D. +28° 1097	64	65	63
21	B. D. +24° 1918	116	128	113
23	B. D. +12° 2213	156	177	151
23	B. D. +12° 2215	47	68	42
Nov. 7	70 Aquarii	254	232	258
7	B. D. −11° 5933	278	256	283
7	B. D. −11° 5932	251	230	256
7	243 B. Aquarii	312	290	317
9	B. D. + 0° 34	288	265	293
9	B. D. + 1° 52	200	177	206
9	B. D. + 2° 54	328	305	334
15	B. D. +27° 880	43	42	43
15	136 Tauri	26	25	26
15	B. D. +27° 914	36	35	36
15	B. D. +28° 958	129	128	129
15	B. D. +28° 966	102	101	102
16	B. D. +27° 1270	132	137	130
Dec. 1	C. D. −25° 14589	250	238	252
8	π Piscium	267	246	272
8	281 B. Piscium	297	275	301
8	B. D. +11° 210	266	245	271
11	χ Tauri	293	283	295
1895, Jan. 1	B. D. − 8° 5991	193	170	198
31	B. D. + 6° 127	293	270	298
Feb. 6	B. D. +27° 1141	265	268	264
6	49 Aurigæ	221	224	220
7	B. D. +25° 1778	305	316	303
8	γ Cancri	287	302	284
Mar. 3	B. D. +25° 677	276	264	278
3	B. D. +25° 681	227	216	229
3	B. D. +25° 682	210	199	211
3	B. D. +25° 692	316	305	317
3	B. D. +25° 703	305	295	306
4	B. D. +27° 738	285	280	285
4	B. D. +27° 737	329	324	329
4	B. D. +27° 743	263	258	263
4	B. D. +27° 744	291	286	291
4	B. D. +27° 746	280	275	280
5	B. D. +27° 1078	298	299	297
5	B. D. +28° 1097	247	249	246
5	B. D. +27° 1090	300	301	299
5	B. D. +27° 1117	274	276	273
6	B. D. +26° 1495	313	320	311
6	134 B. Geminor.	281	288	279
6	B. D. +26° 1514	300	308	298
6	B. D. +26° 1516	288	295	286
6	B. D. +27° 1362	210	226	217
6	B. D. +26° 1525	249	257	248
6	B. D. +26° 1528	272	280	270
6	B. D. +26° 1531	354	1	352
6	B. D. +26° 1539	260	268	258
6	B. D. +26° 1554	307	315	305
6	B. D. +26° 1563	232	240	230
6	B. D. +26° 1561	321	329	310
6	B. D. +26° 1564	210	218	208
6	B. D. +26° 1580	258	267	256
8	B. D. +18° 2176	281	298	277
8	B. D. +18° 2181	239	257	235
8	B. D. +18° 2182	236	254	232
8	B. D. +17° 2092	312	330	308
9	B. D. +11° 2219	276	297	271

BERLIN—Continued.

Date.	Star.	m	m₁	m′
		°	°	°
1895, Mar. 9	B. D. +11° 2222	262	283	257
11	B. D. − 1° 2632	142	165	136
11	42 G. Virginis	147	170	142
12	49 Virginis	78	100	73
29	B. D. +20° 493	295	278	298
29	B. D. +20° 496	241	225	244
30	B. D. +24° 595	216	204	218
30	B. D. +24° 603	260	248	262
30	B. D. +24° 602	219	207	221
31	B. D. +26° 764	308	301	309
31	B. D. +27° 712	268	261	268
31	B. D. +27° 716	280	273	280
31	B. D. +27° 716	278	272	279
Apr. 1	B. D. +28° 930	266	26[illegible]	266
1	B. D. +27° 895	341	339	340
1	B. D. +28° 934	232	231	232
1	B. D. +28° 941	278	276	277
1	B. D. +28° 940	232	231	231
1	B. D. +27° 913	311	310	310
1	B. D. +27° 912	325	324	325
1	B. D. +27° 915	325	324	324
1	B. D. +27° 933	344	343	343
1	B. D. +28° 961	265	264	264
1	B. D. +28° 966	261	260	260
1	B. D. +28° 982	241	240	240
1	B. D. +27° 960	291	291	290
1	B. D. +27° 956	332	332	331
1	B. D. +28° 989	215	214	214
2	Anon.	253	258	251
2	B. D. +27° 1294	241	246	239
2	B. D. +27° 1293	230	236	228
2	B. D. +27° 1293	226	232	225
2	B. D. +27° 1296	263	269	262
2	B. D. +27° 1292	341	346	339
2	B. D. +27° 1295	204	210	203
4	B. D. +19° 2153	282	299	278
4	B. D. +19° 2170	264	281	260
4	B. D. +19° 2171	256	272	252
4	B. D. +19° 2174	262	279	258
7	9 B. Virginis	324	347	318
7	B. D. − 0° 2507	290	314	285
10	B. D. −19° 3899	96	115	93
11	C. D. −23° 12251	100	116	98
11	C. D. 23° 12264	67	82	65
12	C. D. −27° 10030	94	104	93
28	B. D. +27° 866	299	297	298
29	B. D. +27° 1213	278	282	276
29	B. D. +27° 1212	244	248	242
29	B. D. +27° 1236	249	253	247
30	B. D. +24° 1777	327	337	324
30	B. D. +24° 1783	297	308	294
May 1	γ Cancri	248	263	244
1	B. D. +21° 1914	279	294	275
1	B. D. +20° 2224	301	316	297
1	B. D. +20° 2228	290	305	286
1	B. D. +20° 2233	244	259	240
1	B. D. +20° 2232	299	315	296
2	B. D. +15° 2114	305	324	300
2	B. D. +15° 2117	227	242	222
2	B. D. +15° 2118	292	311	287
3	B. D. +10° 2176	267	288	262
5	98 B. Virginis	262	285	257
5	42 G. Virginis	260	284	256
5	B. D. 3° 3264	268	291	263
5	B. D. 3° 3267	287	310	282
5	120 B. Virginis	275	298	270
5	B. D. 4° 3275	256	280	251
5	B. D. 4° 3281	288	311	283
6	B. D. −10° 3624	256	279	252
6	B. D. −10° 3627	292	314	288
1895, May 7	B. D. −16° 3802	268	288	264
28	B. D. +21° 1866	262	276	259
28	B. D. +21° 1868	258	272	255
29	B. D. +16° 1975	332	351	329
30	B. D. +11° 2217	262	283	257
30	B. D. +11° 2221	278	299	273
30	B. D. +11° 2223	283	304	278
30	45 Leonis	328	350	323
31	B. D. + 5° 2467	257	280	252
June 9	284 B. Sagittarii	111	103	114
12	B. D. −15° 6103	170	151	175
12	B. D. −15° 6109	102	82	106
12	B. B. −15° 6111	110	90	114
13	B. D. −10° 5973	87	65	92
13	B. D. −10° 5974	116	94	121
13	65 Aquarii	62	40	67
15	B. D. + 0° 2	109	86	114
15	B. D. + 0° 8	24	0	28
16	B. D. + 6° 114	140	117	145
16	B. D. + 6° 115	73	50	78
27	B. D. + 6° 2387	314	336	309
July 2	C. D. −23° 12194	314	330	312
2	C. D. −23° 12202	306	322	304
2	C. D. −23° 12208	296	313	294
14	B. D. + 9° 148	26	3	30
14	B. D. + 9° 146	105	88	109
14	B. D. +10° 161	104	81	108
15	B. D. +15° 303	77	56	80
15	B. D. +15° 304	62	[illegible]	[illegible]
16	B. D. +19° 433	57	40	60
16	47 Arietis	45	28	48
17	27 Tauri	47	34	49
17	28 Tauri	66	53	68
17	B. D. +24° 589	132	120	134
18	B. D. +26° 759	55	48	55
Aug. 10	B. D. + 8° 158	68	46	73
10	180 B. Piscium	127	104	132
13	B. D. +23° 462	112	98	114
13	B. D. +23° 463	105	90	106
13	B. D. +23° 465	97	82	98
13	B. D. +23° 468	45	31	47
13	B. D. +23° 467	111	96	112
13	B. D. +23° 469	103	89	105
16	B. D. +27° 1133	101	103	99
Sept. 2	B. D. −15° 6119	222	202	226
5	B. D. + 1° 10	62	39	67
5	B. D. + 2° 16	99	76	104
6	60 Piscium	30	7	34
6	62 Piscium	121	98	125
6	B. D. + 6° 111	139	116	143
9	B. D. +21° 413	32	16	34
9	B. D. +21° 416	56	39	58
9	B. D. +21° 427	58	42	60
9	B. D. +22° 463	106	90	108
9	B. D. +22° 466	104	89	106
9	B. D. +22° 468	126	111	128
9	B. D. +22° 469	84	69	86
10	B. D. +24° 613	111	99	112
10	B. D. +25° 667	109	98	110
10	B. D. +24° 616	85	73	86
10	B. D. +25° 671	105	93	106
10	B. D. +24° 617	54	42	54
10	B. D. +25° 677	149	138	150
10	B. D. +25° 678	147	136	148
10	B. D. +25° 681	102	91	103
10	B. D. +25° 682	104	93	105
10	B. D. +25° 685	119	108	120
11	B. D. +27° 733	74	68	74
11	B. D. +27° 738	74	68	74
29	B. D. −17° [illegible]	275	256	280

BERLIN—Continued.

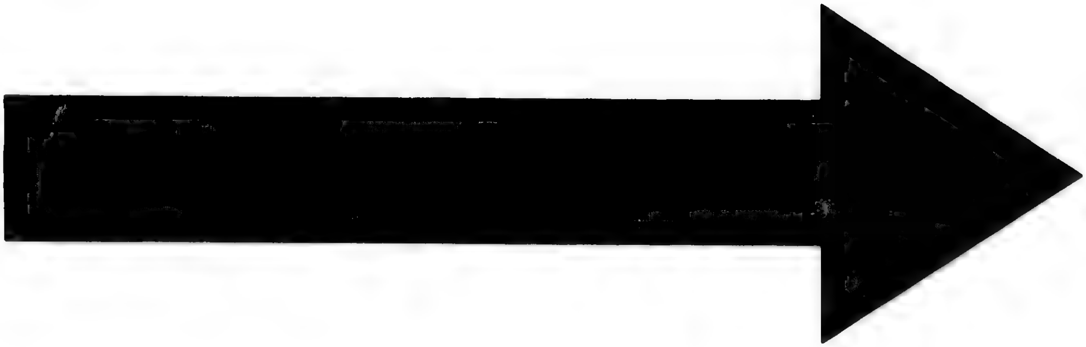
Date.		Star.	m	m_1	m'
			°	°	°
1895, Sept.	29	∂ Capricor.	266	247	271
	29	B. D. −16° 5946	287	268	292
	29	∂ Capricor.	64	44	69
	30	B. D. −11° 5842	275	254	280
	30	58 Aquarii	275	254	280
Oct.	1	282 B. Aquarii	255	232	260
	1	B. D. − 5° 5963	243	220	248
	4	235 B. Piscium	123	101	127
	4	B. D. + 11° 175	116	93	119
	7	η Tauri	27	14	28
	7	24 Tauri	34	21	35
	7	B. D. + 23° 531	40	27	41
	7	B. D. + 23° 540	73	60	74
	7	B. D. + 23° 549	66	53	67
	7	105 B. Tauri	67	54	68
	7	B. D. + 23° 560	63	50	64
	7	B. D. + 23° 561	58	45	59
	7	B. D. + 23° 567	37	24	38
	7	B. D. + 24° 578	61	48	62
	7	B. D. + 24° 595	101	88	102
	7	B. D. + 24° 598	102	90	103
	9	406 B. Tauri	91	90	90
	10	B. D. + 27° 1230	68	72	66
	11	B. D. + 24° 1785	16	26	12
	11	B. D. + 24° 1783	109	119	106
	11	B. D. + 24° 1800	65	76	62
	28	B. D. − 8° 5980	265	242	270
	28	82 Aquarii	269	247	274
	29	B. D. − 2° 6007	307	283	312
	29	B. D. − 2° 6013	258	234	263
	31	B. D. + 8° 158	280	257	284
	31	180 B. Piscium	222	199	226
	31	B. D. + 8° 177	335	312	339
	31	210 B. Piscium	295	273	299
Nov.	1	B. D. + 15° 290	270	249	273
	10	B. D. + 10° 2147	97	76	92
	10	45 Leonis	119	97	114
	25	B. D. − 3° 5638	230	206	234
	28	B. D. + 13° 250	226	204	230
	28	B. D. + 13° 267	262	240	265
	29	B. D. + 18° 310	242	224	245
	30	B. D. + 21° 416	271	254	272
	30	B. D. + 21° 427	267	251	269
	30	B. D. + 22° 466	215	200	216
	30	B. D. + 22° 469	238	222	239
Dec.	6	80 Cancri	140	166	144
	29	B. D. + 26° 750	293	285	292
	29	B. D. + 26° 752	290	282	289
	29	B. D. + 26° 764	282	274	281
	29	B. D. + 27° 716	253	246	252
1896, Jan.	8	B. D. − 10° 3870	133	152	130
	8	B. D. − 10° 3866	60	79	58
	8	B. D. − 10° 3879	140	159	137
	21	B. D. + 8° 153	332	309	336
	21	B. D. + 9° 116	54	231	258
	24	B. D. + 22° 473	90	275	91
	24	B. D. + 22° 475	270	[illegible]	271
	24	B. D. + 22° 475	268	[illegible]	269
	24	B. D. + 22° 480	[illegible]	[illegible]	[illegible]
	24	B. D. + 22° 482	314	[illegible]	315
	24	B. D. + 23° 454	254	239	255
	24	B. D. + 23° 457	337	322	338
	24	B. D. + 23° 469	321	307	322
	24	B. D. + 23° 470	214	200	215
	26	B. D. + 27° 771	315	311	314
	26	B. D. + 27° 778	252	248	250
	26	B. D. + 27° 783	259	256	258
	27	B. D. + 27° 1066	294	295	292
	27	B. D. + 27° 1089	279	282	277
	27	B. D. + 27° 1090	205	207	203
1896, Jan.	28	B. D. + 25° 1644	237	244	233
	28	B. D. + 25° 1659	258	266	255
	28	B. D. + 25° 1700	241	250	238
Feb.	19	B. D. + 17° 339	255	236	258
	19	B. D. + 17° 346	285	266	287
	20	B. D. + 21° 403	195	178	196
	20	B. D. + 22° 438	256	239	257
	20	B. D. + 22° 441	241	225	243
	20	B. D. + 22° 446	276	260	277
	20	B. D. + 22° 453	238	222	239
	20	B. D. + 22° 455	270	255	272
	20	B. D. + 22° 457	238	222	239
	21	B. D. + 24° 598	314	301	314
	21	B. D. + 25° 656	226	214	226
	21	B. D. + 25° 674	262	250	262
	21	B. D. + 25° 677	280	268	280
	21	B. D. + 25° 678	250	239	250
	22	B. D. + 27° 701	290	282	289
	22	B. D. + 27° 712	299	292	298
	22	Anon	264	258	263
	22	B. D. + 27° 716	314	307	313
	22	B. D. + 27° 716	315	308	314
	22	B. D. + 27° 717	262	255	261
	22	B. D. + 27° 722	256	250	256
	22	B. D. + 27° 731	296	290	294
	22	B. D. + 27° 734	231	225	230
	23	B. D. + 27° 888	253	252	251
	23	B. D. + 28° 918	224	222	222
	23	B. D. + 28° 930	233	232	231
	23	B. D. + 27° 909	269	268	267
	23	B. D. + 27° 912	253	252	251
	23	B. D. + 27° 913	241	240	239
	23	B. D. + 27° 915	254	253	252
	23	B. D. + 27° 914	315	314	313
	23	B. D. + 28° 955	234	233	232
	23	B. D. + 27° 932	292	291	290
	23	B. D. + 27° 933	271	270	269
	23	B. D. + 27° 940	336	335	334
	23	B. D. + 27° 938	342	341	340
	23	415 B. Tauri	317	316	315
	23	B. D. + 27° 950	281	280	279
	24	B. D. + 26° 1453	329	335	326
	24	B. D. + 25° 1504	290	296	286
	24	B. D. + 25° 1505	287	294	284
	24	B. D. + 25° 1506	306	312	302
	24	B. D. + 26° 1485	224	230	220
	24	B. D. + 25° 1608	284	291	[illegible]
	24	49 Geminor.	237	243	233
	26	78 Cancri	294	310	289
Mar.	1	B. D. + 27° 799	259	256	258
	1	B. D. + 27° 798	213	210	212
	1	B. D. + 27° 803	274	270	272
	1	107 B. Aurigæ	308	305	306
	1	B. D. + 27° 811	246	243	244
	1	B. D. + 27° 824	236	233	234
	21	B. D. + 27° 830	330	327	328
	21	B. D. + 27° 833	250	248	249
	21	B. D. + 27° 832	337	335	[illegible]
	21	B. D. + 27° 837	280	[illegible]	[illegible]
	21	B. D. + 27° 849	235	[illegible]	[illegible]
	22	B. D. + 27° 1144	262	265	260
	22	B. D. + 27° 1148	307	310	305
	22	B. D. + 27° 1164	220	223	217
	22	B. D. + 27° 1167	298	301	295
	22	B. D. + 27° 1181	284	287	281
	22	B. D. + 26° 1317	300	304	298
	22	B. D. + 26° 1333	344	348	341
	22	B. D. + 26° 1350	310	314	307
	23	B. D. + 25° 1706	279	284	275
	23	B. D. + 25° 1709	248	252	244

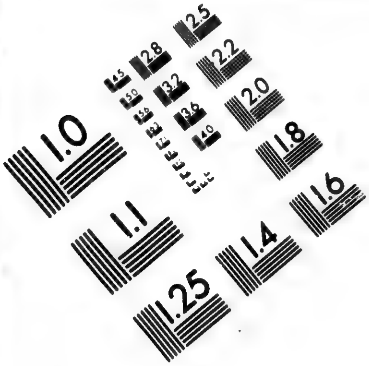
BERLIN—Continued

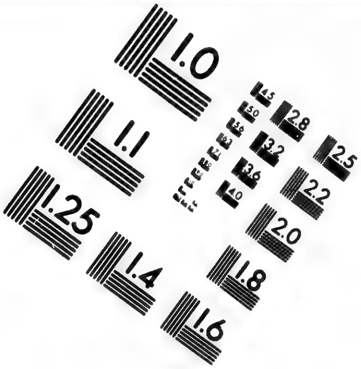
Date.	Star	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1896, Mar. 23	B. D. + 25° 1725	240	245	236	1896, Sept. 14	C. D. − 28° 14144	201	201	204
23	176 B. Geminor.	313	318	309	14	38 B. Sagittarii	241	241	244
23	B. D. + 24° 1729	306	312	302	23	B. D. + 11° 172	91	69	94
23	181 B. Geminor.	325	330	321	26	17 Tauri	31	18	31
23	B. D. + 24° 1740	306	311	302	26	B. D. + 23° 504	108	95	108
23	B. D. + 24° 1746	275	280	271	26	16 Tauri	94	81	94
23	B. D. + 24° 1750	326	335	322	26	q Tauri	111	97	110
23	B. D. + 24° 1755	213	222	209	26	B. D. + 23° 519	21	8	21
25	B. D. + 15° 2075	285	303	280	26	B. D. + 23° 512	73	60	73
25	B. D. + 15° 2079	308	326	302	26	B. D. + 24° 550	102	89	102
25	B. D. + 15° 2080	307	325	302	26	20 Tauri	77	64	76
25	11 Leonis	303	322	298	26	B. D. + 23° 523	36	23	36
25	B. D. + 15° 2091	262	281	257	26	21 Tauri	118	105	118
Apr. 15	B. D. + 23° 462	296	281	297	26	22 Tauri	108	95	108
15	B. D. + 23° 463	298	284	299	26	B. D. + 23° 540	16	2	15
15	B. D. + 23° 469	269	254	269	26	B. D. + 24° 562	89	76	88
20	B. D. + 22° 1901	273	286	269	26	B. D. + 24° 566	96	83	96
20	B. D. + 21° 1807	289	302	285	26	B. D. + 24° 567	111	98	111
26	83 Virginis	254	275	251	26	B. D. + 24° 577	59	46	58
May 16	B. D. + 25° 1570	258	264	254	26	B. D. + 24° 587	143	131	143
16	B. D. + 25° 1579	244	250	240	26	B. D. + 24° 598	89	76	88
16	B. D. + 25° 1590	264	271	261	28	B. D. + 27° 818	100	97	97
16	B. D. + 25° 1584	351	357	347	28	B. D. + 27° 832	123	120	120
17	B. D. + 22° 1836	288	299	283	28	B. D. + 27° 846	72	69	69
17	B. D. + 22° 1834	314	326	310	28	B. D. + 27° 850	53	51	50
17	B. D. + 22° 1852	272	283	267	28	B. D. + 27° 856	58	55	55
21	B. D. + 0° 2801	349	12	344	28	B. D. + 27° 866	160	158	157
21	υ Leonis	272	296	268	29	B. D. + 26° 1276	105	108	101
23	B. D. − 12° 3785	248	270	245	29	B. D. + 26° 1292	56	59	52
25	C. D. − 23° 12133	288	304	288	29	B. D. + 26° 1298	91	94	88
25	C. D. − 23° 12202	222	238	222	29	B. D. + 26° 1304	140	143	136
25	C. D. − 23° 12208	208	224	208	29	B. D. + 26° 1300	109	112	105
31	30 Capricor.	62	44	67	29	B. D. + 26° 1302	64	68	61
June 2	B. D. − 8° 5961	31	9	36	29	B. D. + 26° 1308	88	91	84
2	B. D. − 7° 5873	162	140	167	29	B. D. + 26° 1309	53	6	49
2	B. D. − 8° 5964	50	28	55	29	B. D. + 26° 1311	39	[illegible]	36
3	14 Piscium	129	106	134	29	B. D. + 26° 1326	155	159	152
14	B. D. + 19° 2094	266	280	261	29	B. D. + 26° 1321	104	107	100
14	B. D. + 19° 2095	274	289	269	29	B. D. + 26° 1322	74	77	70
14	B. D. + 19° 2097	200	215	195	29	B. D. + 26° 1327	45	49	41
15	B. D. + 14° 2123	282	300	277	29	B. D. + 26° 1331	112	116	108
22	C. D. − 26° 11106	314	326	314	29	B. D. + 26° 1332	103	107	100
July 6	B. D. + 24° 584	77	64	77	29	B. D. + 26° 1333	104	108	101
6	B. D. + 24° 589	99	86	99	29	B. D. + 26° 1338	64	68	61
6	B. D. + 24° 593	43	31	43	29	B. D. + 26° 1342	47	51	43
27	B. D. 6° 6110	111	89	116	Oct. 18	B. D. − 0° 4558	270	246	274
27	B. D. - 6° 6112	98	76	103	24	B. D. + 25° 703	128	118	127
27	B. D. 6° 6125	16	354	21	24	χ Tauri	50	39	48
Aug. 5	B. D. + 26° 1205	103	105	100	25	B. D. + 26° 827	65	61	62
5	B. D. + 26° 1227	107	109	104	27	B. D. + 25° 1597	126	132	122
5	B. D. + 26° 1230	75	77	72	27	B. D. + 24° 1549	31	37	27
5	B. D. + 27° 1122	155	157	152	27	B. D. + 24° 1562	53	59	49
21	B. D. − 18° 5875	270	253	275	27	B. D. + 24° 1567	41	47	37
23	B. D. − 8° 5932	44	22	49	27	B. D. + 24° 1576	63	70	59
27	B. D. + 14° 249	115	93	117	27	52 Geminor.	104	111	100
28	B. D. + 17° 346	95	76	97	27	B. D. + 25° 1625	116	123	111
28	B. D. + 18° 300	112	93	114	27	B. D. + 24° 1627	98	105	93
28	B. D. + 18° 305	18	359	20	30	B. D. + 11° 2153	78	98	73
28	B. D + 18° 312	51	32	52	30	B. D. + 11° 2162	94	115	89
28	B D. + 19° 362	154	135	155	Nov. 10	B. D. − 22° 5389	246	234	251
28	26 Arietis	111	92	112	12	B. D. − 12° 6153	224	204	230
29	B. D. + 21° 418	76	59	76	12	B. D. − 12° 6152	223	203	228
29	B. D. + 21° 423	56	40	56	13	B. D. − 7° 5837	241	219	246
29	B. D. + 22° 455	114	98	114	13	B. D. − 7° 5847	237	214	241
29	161 B. Arietis	128	112	128	13	B. D. − 7° 5858	291	269	296
29	B. D. + 22° 465	100	84	100	13	B. D. − 7° 5861	281	259	286
30	B. D. + 25° 678	134	123	133	13	B. D − 7° 5866	327	305	332
Sept. 3	B. D. + 22° 1810	44	55	40	15	B. D. + 3° 10	212	189	216
3	B. D. + 22° 1834	41	52	37	15	B. D. + 3° 15	263	240	267
14	C. D. − 28° 14143	247	247	250	15	B. D. + 4° 22	237	213	241

BERLIN Continued

Date.	Star.	m	m₁	m′	Date	Star	m	m₁	m′
		°	°	°			°	°	°
1896, Nov. 16	B. D. + 8° 126	292	269	295	1902, Oct 22	B. D. +16° 1421	103	110	103
16	B. D. + 9° 110	246	223	240	22	B. D. +16° 1423	118	125	118
16	B. D. + 9° 109	212	189	215	22	B. D. +16° 1426	140	147	140
16	B. D. +10° 123	222	200	225	22	λ Geminor.	234	241	234
17	104 Piscium	328	306	330	22	B. D. +16° 1436	63	70	62
26	B. D. +13° 2131	100	110	95	22	B. D. +16° 1441	115	122	114
26	47 B. Leonis	74	92	68	22	λ Geminor.	124	131	123
26	B. D. +13° 2139	64	82	58	22	B. D. +16° 1448	50	58	50
26	B. D. +13° 2147	42	61	37	23	B. D. +14° 1850	94	106	94
Dec. 16	B. D. +22° 438	246	230	246	23	B. D. +14° 1854	84	96	84
17	17 Tauri	283	270	282	24	κ Cancri	84	100	85
17	20 Tauri	242	229	242	24	B. D. +10° 1956	82	99	84
17	q Tauri	196	183	[illegible]	Nov. 8	B. D. 11° 5578	297	[illegible]	295
17	B. D. +23° 523	278	265	[illegible]	8	B. D. −11° 5583	336	[illegible]	334
17	B. D. +24° 562	228	214	227	8	B. D. −11° 5589	295	277	293
17	B. D. +23° 540	290	276	289	11	B. D. − 0° 4566	255	231	[illegible]
17	B. D. +24° 566	217	204	216	11	21 Piscium	192	168	187
17	B. D. +23° 553	296	283	294	14	B. D. +12° 354	261	242	256
17	B. D. +23° 560	299	286	298	14	B. D. +12° 370	266	248	261
17	B. D. +23° 561	305	292	304	17	B. D. +18° 990	120	128	127
17	B. D. +23° 567	330	[illegible]	338	17	B. D. +18° 1001	72	71	70
17	B. D. +24° 578	298	286	298	17	B. D. +18° 1012	146	145	144
17	B. D. +24° 602	[illegible]	253	264	18	B. D. +17° 1302	55	59	54
18	B. D. +26° 775	[illegible]	273	277	18	41 H¹. Geminor.	34	40	33
1897, Jan. 7	252 B. Aquarii	[illegible]	235	262	19	B. D. +15° 1672	87	97	87
10	B. D. +10° 128	273	250	275	19	B. D. +15° 1676	[illegible]	36	26
10	B. D. +11° 146	184	161	186	20	B. D. +12° 1927	103	118	104
10	B. D. +11° 152	240	226	252	20	60 Cancri	100	115	101
1902, May 11	41 H¹. Geminor.	353	359	351	22	34 Sextantis	85	107	89
11	B. D. +16° 1373	294	300	293	22	B. D. + 3° 2406	30	52	34
11	B. D. +17° 1488	228	234	227	22	B. D. + 4° 2378	74	96	78
11	B. D. +16° [illegible]	288	294	287	22	B. D. + 3° 2411	71	93	75
11	B. D. +16° 1385	284	290	283	Dec. 11	34 B. Arietis	263	242	257
14	B. D. + 7° 2203	215	235	217	11	B. D. +10° 292	340	320	335
15	[illegible] Sextantis	255	277	258	11	B. D. +11° 295	270	250	265
17	[illegible] 5° 3487	257	281	262	12	B. D. +13° 494	279	262	274
18	B. D. − 9° 3640	295	318	300	13	180 B. Tauri	202	190	198
19	B. D. −12° 3933	264	285	269	13	B. D. +16° 561	232	220	228
25	B. D. −18° 5155	[illegible]	124	131	13	193 B. Tauri	270	259	266
June 15	86 Virginis	266	287	271	13	δ Tauri	269	258	265
18	B. D. −19° 433	[illegible]	290	284	13	64 Tauri	291	280	287
18	ν Scorpii	[illegible]	292	286	1903, Jan. 6	171 B. Piscium	259	236	254
23	B. D. −15° 5663	62	49	60	9	B. D. +15° 531	263	250	259
25	[illegible] D. − 8° 5791	[illegible]	127	145	12	B. D. +17° 1400	228	232	227
27	[illegible] D. − 0° 4547	[illegible]	84	103	15	B. D. + 7° 2227	84	104	87
28	116 B. Piscium	168	144	[illegible]	15	B. D. + 7° 2232	117	137	120
28	B. D. + 3° 56	99	75	94	18	B. D. − 6° 3656	88	111	93
28	B. D. + 4° 66	113	89	108	19	h Virginis	40	62	45
28	B. D. + 4° 73	93	70	[illegible]	19	B. D. − 9° 3736	132	154	137
July 15	B. D. 18° 4196	263	[illegible]	[illegible]	[illegible]	6 G. Libræ	123	142	128
19	ρ Sagittarii	225	[illegible]	220	[illegible]	B. D. + 3° 86	290	276	294
21	δ Aquarii	41	25	40	6	B. D. +16° 577	299	288	295
21	B. D. −13° 5830	127	111	126	6	B. D. +16° 582	288	278	284
22	B. D. − 9° 5854	125	105	122	6	B. D. +16° 591	304	294	300
28	B. D. +14° 502	163	146	158	6	64 Tauri	213	203	209
Oct. 10	B. D. −16° 5478	232	221	232	6	B. D. +17° 722	219	209	215
11	87 B. Capricor.	295	280	294	6	B. D. +16° 600	292	282	288
19	B. D. +16° 561	136	125	130	6	B. D. +16° 602	322	313	319
19	B. D. +16° 568	96	85	92	6	B. D. +16° 606	265	256	262
19	193 B. Tauri	96	85	92	7	B. D. +18° 825	[illegible]	247	249
21	B. D. +17° 1135	78	78	76	7	115 Tauri	[illegible]	293	294
21	B. D. +17° 1144	71	71	68	9	B. D. +16° 1506	[illegible]	268	259
21	B. D. +18° 1112	137	137	135	9	68 Geminor.	[illegible]	293	284
21	B. D. +17° 1158	52	52	50	9	67 Geminor.	[illegible]	342	333
21	B. D. +17° 1161	49	40	46	9	B. D. +15° [illegible]	[illegible]	317	308
21	124 H¹. Orionis	82	83	80	9	B. D. +16° [illegible]	273	[illegible]	273
21	B. D. +18° 1147	143	144	141	12	155 B. Leonis	[illegible]	[illegible]	82
21	B. D. +18° 1178	128	130	126	15	487 B. Virginis	[illegible]	[illegible]	109
21	B. D. +18° 1179	126	128	124	16	B. D. −11° [illegible]	[illegible]	58	[illegible]
22	B. D. +16° 1419	109	116	109	16	B. D. −11° 3668	[illegible]	130	[illegible]







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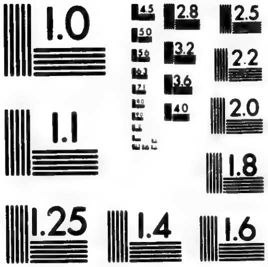

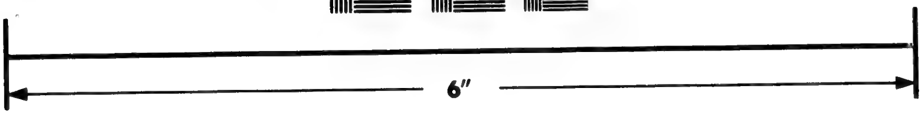

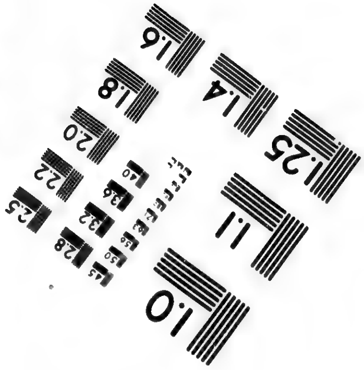

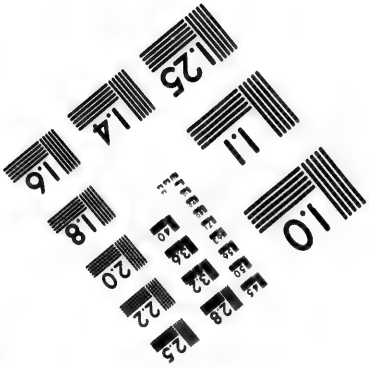

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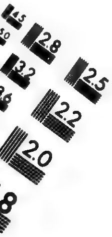
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BERLIN—Continued.

Date.	Star.	m	m_1	m'
		°	°	°
1903, Feb. 16	B. D. −11° 3684	91	111	96
Mar. 2	B. D.+ 6° 195	273	251	268
4	B. D.+13° 499	240	224	236
6	B. D.+17° 841	256	250	253
7	B. D.+17° 1082	296	295	293
7	B. D.+17° 1089	277	276	274
7	B. D.+18° 1061	243	243	241
7	B. D.+18° 1060	228	228	226
7	B. D.+18° 1067	245	245	243
7	B. D.+17° 1101	323	323	321
7	B. D.+17° 1113	285	285	282
7	B. D.+18° 1084	202	202	199
7	B. D.+17° 1135	248	248	245
7	B. D.+17° 1144	247	247	244
7	B. D.+17° 1147	268	268	265
7	B. D.+17° 1151	269	270	266
7	B. D.+17° 1158	242	243	239
1903, Mar. 7	B. D.+17° 1154	341	342	338
8	B. D.+17° 1469	263	268	263
8	B. D.+17° 1477	252	258	252
8	41 H^1. Geminor.	312	317	311
8	B. D.+16° 1373	278	283	277
8	B. D.+16° 1380	273	279	273
8	B. D.+17° 1488	187	193	187
8	B. D.+16° 1385	272	278	272
8	B. D.+16° 1395	265	271	264
8	B. D.+16° 1398	289	295	288
8	B. D.+16° 1400	271	277	270
8	51 Geminor.	310	317	310
8	B. D.+16° 1421	199	206	198
12	B. D.+ 2° 2386	274	297	279
12	p^4 Leonis	252	275	257
17	34 Libræ	90	105	94
17	ζ Libræ	63	77	67

CAMBRIDGE, ENGLAND.

Date.	Star.	m	m_1	m'
1791, June 12	λ Virginis	223	242	228
1793, Apr. 19	ξ Leonis	327	344	331
1794, Mar. 5	μ Ceti	275	257	273
7	α Tauri	208	197	209
Nov. 8	α Tauri	279	270	281
8	α Tauri	112	103	114
Dec. 18	γ Libræ	102	116	101
1795, Oct. 6	δ Cancri	54	67	59
1797, Mar. 17	ν Scorpii	137	148	132
Dec. 25	33 Piscium	242	219	243
1798, Oct. 5	η Leonis	234	253	234
1799, Apr. 10	125 Tauri	271	267	275
1800, Sept. 30	ψ Aquarii	305	283	310
Nov. 26	ζ Piscium	211	189	216
1801, Mar. 30	α Virginis	296	318	291
30	α Virginis	88	110	83
May 21	χ Leonis	311	333	306
24	α Virginis	299	321	294
24	α Virginis	89	111	84
Oct. 23	η Tauri	235	223	238
23	η Tauri	104	92	107
23	27 Tauri	62	50	65
23	28 Tauri	80	68	82
1811, Mar. 1	α Tauri	266	257	264
1	α Tauri	101	92	99
Oct. 27	λ Aquarii	298	276	293
1813, Mar. 6	μ Ceti	248	230	247
8	α Tauri	260	251	255
July 11	μ Sagittarii	305	305	302
Nov. 29	δ Capricor.	313	295	308
1814, Jan. 1	μ Ceti	223	205	224
28	ξ^2 Ceti	285	266	285
Feb. 1	ν Geminor.	294	296	298
Oct. 1	μ Ceti	285	267	287
1820, Feb. 1	χ Leonis	300	322	296
1	χ Leonis	78	100	73
1821, Feb. 6	δ Piscium	224	201	228
May 6	κ Geminor.	302	310	298
Oct. 13	17 Tauri	297	285	298
13	q Tauri	231	219	232
13	20 Tauri	262	250	263
13	17 Tauri	47	35	47
13	16 Tauri	84	72	84
15	136 Tauri	227	225	225
15	136 Tauri	124	122	122
1822, Sept. 6	q Tauri	279	267	278
1823, Jan. 24	ε Geminor.	280	283	275
May 18	p^5 Leonis	308	331	305
1824, Jan. 7	19 Piscium	217	194	219
1825, Apr. 1	c Leonis	295	318	295
1826, Jan. 13	19 Piscium	239	216	237
1827, Dec. 8	ω Leonis	102	119	103
1829, Jan. 18	λ Geminor.	305	311	306
Oct. 15	α Tauri	216	207	214
15	α Tauri	138	129	136
1830, Mar. 28	θ^1 Tauri	287	277	286
28	θ^2 Tauri	309	299	308
28	85 Tauri	335	325	334
29	117 Tauri	309	305	309
Apr. 5	τ Leonis	268	291	273
May 1	48 Leonis	256	277	261
1831, Feb. 20	111 Tauri	310	306	311
Oct. 23	α Tauri	284	275	286
23	α Tauri	63	54	65
1847, Jan. 25	180 B. Tauri	230	218	226
Feb. 24	u Geminor.	234	238	233
Apr. 22	A^2 Cancri	241	256	243
May 23	υ Leonis	269	292	274
28	ζ Libræ	246	261	251
June 1	ρ Sagittarii	259	252	259
1	ρ Sagittarii	101	93	101
Nov. 18	44 Piscium	329	306	324
1848, Jan. 16	α Tauri	308	298	306
16	α Tauri	47	38	45
Mar. 21	m Virginis	224	245	228
June 13	30 Libræ	240	255	243
July 11	θ Libræ	335	348	338
15	246 B. Sagittarii	318	310	316
Aug. 21	γ Tauri	249	239	248
21	γ Tauri	106	96	105
Nov. 9	ξ^1 Ceti	325	305	321
9	ξ^1 Ceti	33	14	30
Dec. 4	20 Piscium	222	236	217
1849, Jan. 3	ξ^1 Ceti	216	202	218
Mar. 2	130 Tauri	246	244	248
3	26 Geminor.	292	295	294
8	82 Leonis	339	1	344
Sept. 5	ν Piscium	216	194	213
5	ν Piscium	141	120	138
8	71 Tauri	112	102	112
8	θ^2 Tauri	203	193	204
8	81 Tauri	275	266	276
8	80 Tauri	69	60	70
8	81 Tauri	74	65	75
1850, Jan. 23	γ Tauri	214	227	215
23	γ Tauri	86	98	87
23	θ^1 Tauri	262	274	263
Apr. 15	α Tauri	91	82	92
May 28	36 Sagittarii	273	268	269
28	36 Sagittarii	103	98	98

CAMBRIDGE, ENGLAND—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1850, July 21	21 Sagittarii	220	219	216	1854, Sept. 30	ω Sagittarii	262	252	259
21	21 Sagittarii	147	145	143	30	A Sagittarii	270	259	267
24	21 Capricor.	292	276	287	1855, Mar. 23	k Tauri	230	223	234
Aug. 2	α Tauri	280	271	282	Apr. 23	λ Cancri	80	93	81
14	γ Libræ	260	274	259	June 27	22 Scorpii	82	92	77
14	γ Libræ	102	116	101	Aug. 30	ο Piscium	261	239	266
Sept. 12	29 Ophiuchi	210	216	207	Sept. 20	234 B. Sagittarii	239	232	238
Nov. 21	64 Orionis	106	105	110	21	40 B. Capricor.	241	228	241
21	68 Orionis	275	275	279	Oct. 24	ο Piscium	300	279	305
1851, Jan. 15	64 Orionis	238	238	243	Nov. 15	86 B. Capricor.	254	238	254
Mar. 13	θ Cancri	258	272	263	1856, Mar. 11	33 Tauri	239	227	243
Apr. 6	m Tauri	274	268	277	13	136 Tauri	269	268	272
6	m Tauri	88	82	91	26	α Scorpii	289	299	285
7	χ^2 Orionis	265	265	270	June 16	α Scorpii	281	291	277
July 21	ξ^2 Ceti	150	131	151	July 25	63 Arietis	182	167	186
Sept. 14	μ Ceti	113	95	114	Sept. 20	136 Tauri	329	327	330
Oct. 2	222 B. Sagittarii	106	98	100	20	136 Tauri	13	12	15
11	ξ^2 Ceti	307	288	308	Nov. 11	40 Arietis	225	207	230
11	ξ^2 Ceti	45	26	46	1857, Mar. 4	49 Aurigæ	96	99	96
Dec. 10	63 Geminor.	247	254	252	Apr. 2	λ Cancri	251	263	248
10	63 Geminor.	70	78	75	2	λ Cancri	131	143	128
1852, Feb. 3	63 Geminor.	266	274	272	May 6	α Virginis	75	98	70
May 2	94 Virginis	304	324	302	Sept. 30	50 Aquarii	293	272	297
July 4	29 Aquarii	118	98	114	Oct. 6	27 Tauri	218	205	221
Aug. 26	36 B. Capricor.	319	306	315	6	27 Tauri	126	112	128
1853, Jan. 14	30 Piscium	141	118	141	6	28 Tauri	186	173	188
14	33 Piscium	255	232	255	6	28 Tauri	157	144	160
14	33 Piscium	89	66	89	Nov. 27	ε Piscium	311	288	316
Feb. 17	*n* Tauri	230	225	235	1858, Feb. 19	ε Arietis	227	210	230
Mar. 26	95 Virginis	276	297	273	20	*q* Tauri	257	243	259
26	95 Virginis	105	125	102	20	*q* Tauri	87	74	89
Apr. 20	ν Virginis	93	116	93	20	20 Tauri	57	44	59
May 20	95 Virginis	263	283	259	May 18	83 Cancri	199	217	195
20	95 Virginis	120	140	117	19	α Leonis	344	4	339
Sept. 20	38 Arietis	271	253	275	19	α Leonis	42	62	37
Dec. 9	33 Ceti	182	160	185	Aug. 30	16 Tauri	303	289	304
1854, Feb. 7	121 Tauri	279	276	284	30	*q* Tauri	272	258	273
9	52 Geminor.	294	301	298	30	*q* Tauri	70	56	71
9	52 Geminor.	61	68	65	30	20 Tauri	308	294	309
Mar. 12	42 Leonis	307	328	307	Sept. 18	17 Capricor.	226	211	231
12	167 B. Leonis	257	278	257	Nov. 22	136 Tauri	259	257	257
Apr. 4	ε Geminor.	345	349	350	22	136 Tauri	93	91	91
May 9	48 Virginis	297	319	293	1859, Feb. 16	ψ Leonis	248	267	243
9	48 Virginis	82	105	78	1860, Feb. 28	16 Tauri	333	320	332
Sept. 4	35 Capricor.	278	260	277	28	20 Tauri	316	303	315
4	35 Capricor.	69	51	68	28	22 Tauri	279	266	278

CAMBRIDGE, MASS.

1840, July 10	τ Scorpii	320	328	321	1847, Jan. 5	34 Sextantis	69	91	72
Oct. 6	45 Capricor.	236	218	241	25	δ Tauri	326	316	323
Nov. 2	ι Capricor.	241	225	246	25	68 Tauri	246	236	242
1842, Apr. 12	ε Arietis	305	289	303	Aug. 19	7 Ophiuchi	313	323	316
1843, Jan. 24	σ Scorpii	57	67	62	Sept. 16	29 Ophiuchi	286	293	288
Sept. 30	39 Sagittarii	219	214	224	1848, Jan. 12	80 Piscium	267	245	262
Nov. 3	45 Piscium	263	240	262	Feb. 12	α Tauri	331	322	329
1844, Feb. 22	104 Piscium	291	270	287	12	α Tauri	20	11	18
1845, July 16	58 Ophiuchi	248	250	253	Mar. 11	111 Tauri	320	316	319
17	29 Sagittarii	285	281	289	Apr. 12	ο Leonis	274	292	278
Sept. 22	57 Orionis	117	115	113	May 4	α Tauri	317	308	315
22	64 Orionis	86	85	82	Aug. 7	η Libræ	232	245	234
Nov. 10	ϑ Piscium	295	272	290	Sept. 15	65 Ceti	90	70	86
Dec. 6	22 Piscium	292	269	289	Oct. 28	η Libræ	235	248	236
1846, Feb. 6	71 Orionis	287	288	284	1849, Jan. 5	γ Tauri	280	270	280
20	16 Sagittarii	66	65	70	5	γ Tauri	68	58	68
Mar. 31	97 Tauri	302	295	298	5	75 Tauri	246	236	245
May 3	ω Leonis	218	235	219	6	111 Tauri	295	291	296
June [illegible]9	69 Leonis	296	319	299	Feb. 9	5 Virginis	286	309	291
1847, Jan. 3	65 Cancri	109	124	109	Mar. 11	95 Virginis	122	142	125

CAMBRIDGE, MASS.—Continued.

Date.	Star.	m	m₁	m′	Date.	Star.	m	m₁	m′
		°	°	°			°	°	°
1849, May 2	5 Virginis	275	298	280	1850, May 19	σ Leonis	291	314	296
July 16	α Tauri	249	240	250	19	σ Leonis	78	101	82
16	α Tauri	106	97	106	June 13	82 Cancri	286	302	290
Sept. 27	29 Capricor.	321	305	317	14	α Leonis	272	292	277
Nov. 22	40 Aquarii	290	270	286	14	α Leonis	95	115	100
29	θ^2 Tauri	298	288	299	Aug. 8	α Leonis	337	357	342
29	α Tauri	266	257	267	8	α Leonis	25	45	30
1850, Jan. 23	θ^2 Tauri	271	261	272	27	73 Ceti	252	233	252
23	α Tauri	247	238	248	27	73 Ceti	96	77	96
23	α Tauri	100	91	101	30	α Tauri	303	294	305
Feb. 26	σ Leonis	259	282	264	Oct. 13	7 Capricor.	240	228	236
Mar. 24	27 Leonis	202	221	207	14	23 Capricor.	232	216	227
Apr. 15	α Tauri	304	295	306	21	87 Ceti	220	202	220
15	α Tauri	41	32	43	21	87 Ceti	129	111	128
18	g Geminor.	225	235	230					

CAPE OF GOOD HOPE.

		*					*		
1834, July 14	8 G. Libræ	250	270	248	1844, June 25	40 H. Virginis	206	217	201
Aug. 30	κ Geminor.	94	89	94	25	40 H. Virginis	156	168	152
1835, Jan. 18	ξ Virginis	229	249	225	1847, Apr. 25	d Leonis	251	268	250
18	ξ Virginis	154	173	150	June 17	o Leonis	277	290	274
June 12	h Sagittarii	250	244	248	Oct. 18	ν Aquarii	289	279	293
14	ε Capricor.	302	289	305	1848, Apr. 15	B. A. C. 4019	325	343	325
Aug. 6	51 Sagittarii	229	220	225	May 17	γ Libræ	283	299	287
6	h Sagittarii	265	261	265	June 8	τ Leonis	316	333	315
6	h Sagittarii	108	103	107	1849, Feb. 13	ξ Libræ	100	119	104
8	κ Capricor.	300	286	303	Apr. 6	γ Virg. (N)	287	306	288
Oct. 29	κ Capricor.	242	222	240	6	γ Virg. (S)	287	306	288
1836, Feb. 8	4 G. Libræ	119	142	117	July 13	ξ^1 Ceti	13	359	18
Aug. 22	φ Sagittarii	267	267	267	Sept. 25	ρ Sagittarii	224	217	220
22	φ Sagittarii	92	92	92	25	ρ Sagittarii	126	119	123
Sept. 16	ρ Ophiuchi	241	252	238	Oct. 3	ξ^1 Ceti	44	29	47
21	ε Capricor.	262	242	261	Nov. 23	λ Aquarii	245	226	243
Oct. 21	27 Piscium	230	200	227	23	λ Aquarii	98	80	97
21	29 Piscium	255	226	253	26	μ Piscium	227	204	223
1837, June 16	δ Scorpii	226	239	222	Dec. 1	ν Geminor.	137	132	133
Aug. 11	O. A. 16481	270	278	270	1850, Jan. 17	φ Aquarii	238	217	235
1838, Aug. 12	q Tauri	42	30	46	23	64 Tauri	214	198	210
Oct. 5	ε Arietis	49	31	52	25	ν Geminor.	250	246	248
Nov. 29	ε Arietis	309	292	312	25	ν Geminor.	109	106	107
1839, May 6	δ Capricor.	109	83	107	Feb. 21	64 Orionis	324	324	328
24	α Virginis	352	24	357	21	χ^2 Orionis	223	216	219
24	α Virginis	19	50	24	Apr. 17	ν Geminor.	304	306	307
June 24	α Scorpii	244	253	242	July 30	ν Piscium	68	51	70
Aug. 17	A^1 Scorpii	277	292	278	Aug. 31	χ^2 Orionis	322	322	326
17	A^2 Scorpii	255	268	253	Sept. 1	ζ Geminor.	90	91	90
1840, Feb. 15	γ Cancri •	338	2	343	30	δ Cancri	74	84	75
Mar. 23	α Scorpii	118	126	116	Nov. 17	ξ^1 Ceti	194	169	189
May 9	ρ Leonis	287	313	287	17	ξ^1 Ceti	152	128	148
18	3 Sagittarii	107	106	106	1851, Mar. 9	68 Tauri	272	259	272
19	φ Sagittarii	265	259	265	26	υ Capricor.	223	210	219
19	φ Sagittarii	94	87	94	Apr. 18	24 Scorpii	162	169	157
20	h Sagittarii	270	258	270	May 17	μ Sagittarii	310	318	314
20	h Sagittarii	100	87	99	17	μ Sagittarii	33	40	37
22	ι Capric	284	264	285	18	36 Sagittarii	222	218	218
22	ι Capric	54	34	57	18	ξ Sagittarii	331	336	336
June 12	A^1 Scorpii	296	311	298	18	ξ Sagittarii	38	42	42
1841, June 30	α Scorpii	288	297	290	June 7	c Virginis	233	251	230
1843, Sept. 11	η Piscium	187	173	192	17	ι Capricor.	122	107	120
1844, Jan. 8	π Leonis	272	293	272	July 12	π Sagittarii	281	282	282
8	π Leonis	98	119	97	Aug. 8	ξ Sagittarii	249	248	247
31	2 Geminor.	241	248	243	8	ξ Sagittarii	117	115	115

* See note, page 119.

CAPE OF GOOD HOPE—Continued.

Date.	Star.	m*	m$_1$	m′
		°	°	°
1851, Oct. 28	30 G. Sagittarii	311	320	315
Dec. 7	ε Tauri	226	209	222
7	ε Tauri	119	103	117
21	ν Piscium	295	271	293
1852, Feb. 5	o Sagittarii	246	244	244
15	o Sagittarii	138	133	134
Mar 9	ξ Libræ	242	260	240
9	ξ Libræ	145	160	141
Sept. 23	η Capricor.	316	308	320
1853, Apr. 20	ξ Virginis	207	225	202
Sept. 6	88 Virginis	253	276	251
8	174 B. Libræ	295	315	297
11	126 B. Sagittarii	306	310	309
Dec. 8	54 B. Ceti	330	310	335
1854, Mar. 7	139 Tauri	338	338	343
7	139 Tauri	21	20	26
20	b Ophiuchi	95	104	95
22	h Sagittarii	263	258	262
22	h Sagittarii	117	110	115
Apr. 13	κ Virginis	308	336	311
13	κ Virginis	74	99	75
15	ω^1 Scorpii	42	63	46
May 11	6 B. Libræ	244	265	242
11	μ Libræ	239	259	236
11	μ Libræ	132	151	129
22	μ Piscium	253	225	251
June 7	κ Virginis	258	282	257
7	κ Virginis	60	86	62
14	κ Capricor.	245	226	243
14	κ Capricor.	129	108	126
28	ξ Cancri	242	255	240
28	79 Cancri	222	233	218
July 5	μ Libræ	212	229	207
13	ψ^3 Aquarii	44	23	47
Sept. 2	201 B. Sagittarii	242	237	240
2	201 B. Sagittarii	104	99	103
Oct. 29	κ Capricor.	263	243	262
Nov. 27	ψ^2 Aquarii	274	249	274
27	ψ^2 Aquarii	64	40	66
1855, Jan. 3	υ Geminor.	110	114	108
Apr. 4	8 Libræ	118	139	116
4	α Libræ	273	296	273
4	α Libræ	115	136	113
8	φ Sagittarii	248	246	246
8	φ Sagittarii	134	131	131
May 8	ε Capricor.	231	209	228
1856, Apr. 25	τ Sagittarii	267	262	267
25	τ Sagittarii	88	87	88
Sept. 8	38 B. Sagittarii	297	300	299
Nov. 12	η Tauri	275	259	276
1857, Jan. 15	η Virginis	236	261	233
15	η Virginis	157	181	153
Feb. 6	φ Geminor.	242	251	240
Mar. 16	σ Scorpii	252	263	250
16	σ Scorpii	140	149	136
16	α Scorpii	266	278	266
18	38 B. Sagittarii	185	181	180
18	38 B. Sagittarii	16	22	21
19	τ Sagittarii	36	34	40
31	κ Aurigæ	240	238	237
Apr. 29	φ Geminor.	262	273	261
May 31	β Virginis	327	359	331
July 27	α Virginis	306	336	309
Nov. 23	γ Capricor.	281	259	282
23	γ Capricor.	47	28	50
1858, Mar. 6	α Scorpii	259	269	258
6	α Scorpii	124	132	121
Oct. 12	X Sagittarii	252	250	250
14	h Sagittarii	270	258	270
1859, Jan. 21	c Leonis	105	131	104
1859, Feb. 8	η Piscium	230	201	226
11	φ Tauri	341	337	346
Aug. 18	η Piscium	183	154	178
18	η Piscium	161	132	156
Oct. 28	α Scorpii	280	289	281
28	α Scorpii	63	69	62
Nov. 8	η Piscium	218	190	214
Dec. 21	σ Scorpii	250	257	248
21	α Scorpii	301	311	304
1860, Feb. 13	A Scorpii	296	310	298
Mar. 7	υ Leonis	315	346	319
7	υ Leonis	65	94	67
12	α Scorpii	306	316	309
12	α Scorpii	66	75	68
28	354 B. Tauri	227	222	223
Apr. 27	μ Cancri	231	245	228
May 1	υ Leonis	297	326	299
8	λ Sagittarii	131	122	128
25	δ Cancri	301	324	304
June 3	A^2 Ophiuchi	285	288	286
3	A^2 Ophiuchi	53	57	56
3	A^1 Ophiuchi	53	57	56
Aug. 24	A^1 Ophiuchi	298	302	301
30	θ Aquarii	99	72	98
Oct. 17	22 Scorpii	228	230	224
1862, Dec. 7	μ Geminor.	88	95	88
13	p^5 Leonis	286	311	288
1863, Jan. 27	ζ Arietis	278	268	279
Mar. 12	58 Ophiuchi	85	83	85
Apr. 7	ω Ophiuchi	239	240	236
8	58 Ophiuchi	264	261	264
May 4	ω^2 Scorpii	214	216	210
June 28	ω^2 Scorpii	221	224	217
28	ω^2 Scorpii	161	162	156
30	21 Sagittarii	111	102	109
Nov. 17	ξ Aquarii	284	266	285
1864, Feb. 29	ψ Ophiuchi	277	283	285
29	ψ Ophiuchi	98	102	97
Mar. 24	α Virginis	303	323	306
24	α Virginis	75	94	76
27	ν Scorpii	226	228	222
Apr. 27	e Sagittarii	127	113	124
July 18	e Sagittarii	243	229	240
18	e Sagittarii	103	91	102
Dec. 6	κ Piscium	275	254	275
6	κ Piscium	67	49	69
1865, Mar. 15	λ Virginis	319	337	323
15	λ Virginis	42	60	46
1866, May 11	ζ Piscium	265	248	265
20	o Leonis	352	348	357
July 8	68 Tauri	86	79	86
26	e Sagittarii	284	277	285
26	e Sagittarii	101	92	100
Aug. 29	o Piscium	98	80	97
Sept. 15	φ Ophiuchi	213	216	209
15	φ Ophiuchi	151	154	147
1867, Jan. 29	φ Ophiuchi	14	27	19
Apr. 16	η Virginis	241	257	238
16	η Virginis	137	152	134
Dec. 28	τ Capricor.	309	302	312
1868, Apr. 4	χ Leonis	292	312	294
Aug. 9	ξ^1 Ceti	287	271	289
1869, Mar. 23	δ Cancri	229	234	225
23	δ Cancri	158	163	153
Aug. 19	ρ Capricor.	185	172	180
19	ρ Capricor.	168	155	163
29	δ Tauri	268	255	268
29	δ Tauri	73	62	74
1870, Feb. 22	24 Scorpii	225	233	221
22	24 Scorpii	161	168	156

*See note, page 119.

CAPE OF GOOD HOPE—Continued.

Date.	Star.	m*	m_1	m'	Date.	Star.	m*	m_1	m'
		°	°	°			°	°	°
1870, Mar. 10	ζ Tauri	290	285	292	1882, Nov. 18	138 B. Aquarii	226	203	222
23	15 Sagittarii	139	139	135	18	B. D.–5° 5738	191	166	186
Sept. 7	δ Capricor.	280	266	281	Dec. 5	α Virginis	324	345	328
7	δ Capricor.	54	42	57	5	α Virginis	43	65	47
28	γ Libræ	221	234	217	1883, Feb. 14	164 B. Tauri	299	231	302
28	γ Libræ	141	154	137	Apr. 28	54 Sagittarii	21	15	26
Dec. 27	ψ^1 Aquarii	253	231	251	May 13	h Leonis	245	260	243
27	ψ^2 Aquarii	334	318	339	July 19	e Sagittarii	261	244	260
1871, Feb. 1	1 Geminor.	264	257	263	Sept. 7	32 Libræ	229	235	225
1	1 Geminor.	90	85	90	Nov. 13	29 Arietis	251	235	249
May 5	θ Libræ	118	133	116	1884, Jan. 2	44 Aquarii	274	256	274
June 29	θ Libræ	253	268	251	7	o Arietis	315	306	319
1875, Aug. 10	σ Scorpii	238	248	235	Mar. 8	209 B. Cancri	306	324	309
1876, Mar. 5	ι Geminor.	297	308	299	9	89 B. Leonis	291	310	293
1879, Oct. 31	20 Tauri	66	58	68	9	π Leonis	290	309	292
1880, Feb. 5	θ Ophiuchi	269	269	269	15	μ Libræ	61	76	63
5	θ Ophiuchi	111	109	109	24	κ Aquarii	115	95	113
18	χ Tauri	263	256	262	May 1	29 Cancri	350	8	355
Mar. 3	26 Ophiuchi	36	42	40	30	89 B. Leonis	324	345	328
4	7 Sagittarii	102	97	101	June 5	μ Libræ	315	330	317
4	9 Sagittarii	88	84	88	Oct. 28	c^1 Capricor.	319	308	323
30	B. A. C. 5641	70	74	72	28	c^1 Capricor.	13	3	18
Apr. 1	ν^2 Sagittarii	91	81	91	Nov. 29	54 Ceti	210	189	205
2	f Sagittarii	91	77	91	Dec. 1	148 B. Tauri	273	264	274
26	19 Scorpii	70	77	72	1885, Jan. 4	48 Leonis	107	124	106
May 26	o Sagittarii	274	263	274	Mar. 4	κ Virginis	108	122	107
June 13	83 B. Leonis	212	230	207	Apr. 2	γ Libræ	239	247	236
13	89 B. Leonis	285	309	286	2	γ Libræ	133	140	130
13	89 B. Leonis	92	115	92	4	125 B. Ophiuchi	22	31	27
14	34 Sextantis	275	300	275	May 5	16 B. Capricor.	33	27	37
18	43 H. Virginis	254	269	252	5	β Capricor.	28	22	32
20	19 Scorpii	294	302	296	22	τ Leonis	286	306	288
21	39 Ophiuchi	285	286	286	24	θ Virginis	282	301	283
25	c^1 Capricor.	282	261	283	June 23	γ Libræ	243	252	241
25	c^1 Capricor.	50	30	53	25	125 B. Ophiuchi	264	268	264
30	4 Arietis	46	112	49	25	164 B. Ophiuchi	241	242	238
July 19	4 Sagittarii	42	129	46	28	54 Sagittarii	146	134	142
19	1 Sagittarii	294	291	296	July 1	θ Aquarii	64	50	66
20	o Sagittarii	269	259	269	26	β Capricor.	223	210	219
20	o Sagittarii	102	90	101	26	β Capricor.	128	116	125
27	η Piscium	76	57	77	1886, Jan. 14	38 Arietis	269	255	269
30	36 Tauri	27	24	31	Feb. 9	122 G. Piscium	210	188	205
Aug. 16	28 Sagittarii	264	254	263	13	m Tauri	204	193	199
16	30 Sagittarii	290	283	292	14	71 Orionis	255	253	254
16	31 Sagittarii	265	254	264	May 14	46 Virginis	275	294	275
Oct. 7	δ Scorpii	216	220	212	16	ξ Libræ	278	294	279
10	π Sagittarii	308	300	311	21	ρ Sagittarii	298	297	301
10	π Sagittarii	25	18	29	21	ρ Sagittarii	58	56	60
Dec. 12	26 Arietis	252	234	250	June 6	o^1 Cancri	255	265	254
1881, Mar. 8	1 Geminor.	348	358	353	10	γ Virg. N)	233	249	230
18	40 H. Virginis	142	154	138	10	γ Virg. S)	273	292	273
Oct. 3	19 Aquarii	231	209	228	10	γ Virg. N)	107	125	106
31	138 B. Aquarii	271	250	271	10	γ Virg. S)	107	125	106
Nov. 1	3 Piscium	221	195	217	15	125 B. Ophiuchi	297	305	299
Dec. 24	ξ Aquarii	239	216	236	July 8	66 Virginis	313	335	317
27	d Piscium	266	245	266	Aug. 24	71 Orionis	49	51	52
1882, Feb. 7	χ Virginis	106	125	105	Sept. 5	164 B. Ophiuchi	293	300	295
11	ω^2 Scorpii	80	88	81	Oct. 7	18 Aquarii	270	257	270
12	116 B. Ophiuchi	95	96	95	Nov. 1	ρ Sagittarii	255	250	254
Mar. 8	621 B. Virginis	81	98	82	12	64 Tauri	121	109	119
Apr. 20	247 B. Tauri	305	304	308	14	68 Orionis	126	121	123
May 6	16 Sagittarii	79	74	80	Dec. 6	μ Piscium	255	236	254
29	621 B. Virginis	273	289	273	1887, Jan. 11	7 Leonis	127	137	124
June 4	g Sagittarii	138	121	134	19	78 B. Ophiuchi	124	130	121
July 2	β Capricor.	349	339	354	Feb. 1	3 B. Tauri	294	281	296
21	χ Virginis	256	275	255	4	57 Orionis	237	230	234
Aug. 18	50 Virginis	252	268	250	18	246 B. Sagittarii	47	47	50
27	19 Aquarii	281	264	282	Mar. 14	φ Ophiuchi	33	47	37
27	ξ Aquarii	203	180	198	31	68 Orionis	277	275	278
Sept. 7	5 Cancri	42	59	46	Apr. 4	α Leonis	298	315	300

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* See note, page 119.

CAPE OF GOOD HOPE—Continued.

Date.	Star.	m*	m_1	m′
		°	°	°
1887, Apr. 4	α Leonis	76	92	77
6	b Virginis	260	278	259
9	18 Libræ	125	138	122
15	47 B. Capricor.	56	50	59
15	61 B. Capricor.	136	124	133
May 1	ψ Leonis	269	282	269
June 3	18 Libræ	271	287	271
13	4 Ceti	24	9	28
13	5 Ceti	36	21	40
July 29	φ Ophiuchi	300	314	303
Aug. 1	190 B. Sagittarii	298	299	300
1	d Sagittarii	230	224	226
8	64 Aquarii	72	57	73
14	χ^2 Orionis	112	106	110
Sept. 3	27 Piscium	47	31	50
3	29 Piscium	74	56	75
13	θ Cancri	44	55	47
Nov. 7	δ Cancri	73	84	74
21	42 Capricor.	235	218	232
22	σ Aquarii	227	207	223
22	58 Aquarii	300	286	303
24	4 Ceti	284	265	285
24	5 Ceti	276	257	277
24	19 B. Ceti	245	223	243
Dec. 17	ρ Capricor.	270	261	270
17	34 B. Capricor.	284	276	285
1888, Jan. 15	μ Capricor.	274	259	274
27	85 Geminor.	328	338	332
Mar. 9	44 Capricor.	133	117	130
9	45 Capricor.	27	17	31
18	δ Tauri	303	294	306
25	l Leonis	342	5	347
July 17	ξ Libræ	306	327	309
17	18 Libræ	211	225	207
20	16 G. Sagittarii	261	265	260
21	36 Sagittarii	220	216	216
21	ξ Sagittarii	323	327	327
21	ξ Sagittarii	29	33	33
23	19 Capricor.	95	105	95
23	21 Capricor.	134	120	131
23	θ Capricor.	95	84	95
25	70 Aquarii	155	133	151
28	35 Ceti	98	75	97
Aug. 17	121 B. Sagittarii	320	325	324
Sept. 13	15 Sagittarii	247	249	245
13	21 Sagittarii	224	222	220
Oct. 9	29 Ophiuchi	230	236	227
15	70 Aquarii	259	240	258
Nov. 15	ν Piscium	304	286	307
Dec. 20	μ Cancri	87	93	87
1889, Jan. 8	35 Ceti	334	317	339
14	141 Tauri	210	199	205
Feb. 5	ν Piscium	330	313	335
Mar. 10	η Geminor.	296	295	298
11	44 Geminor.	326	331	330
23	14 Sagittarii	96	100	96
Apr. 20	30 Sagittarii	70	73	72
20	31 Sagittarii	138	134	134
June 5	167 B. Leonis	288	309	290
5	46 Leonis	237	252	234
10	13 Libræ	299	222	302
July 19	64 Ceti	87	66	87
Aug. 8	168 B. Sagittarii	328	333	333
Sept. 4	ν^2 Sagittarii	328	333	333
30	190 B. Ophiuchi	255	263	254
Nov. 29	74 Aquarii	255	234	254
Dec. 1	15 Ceti	200	171	195
29	33 Ceti	314	295	318
31	38 Arietis	231	207	228
1890, Feb. 12	θ Libræ	125	139	122
1890, Mar. 14	117 B. Sagittarii	118	118	116
Apr. 7	30 Libræ	115	132	113
15	ψ^3 Aquarii	100	77	99
28	η Leonis	300	321	303
May 9	329 B. Sagittarii	138	127	134
30	566 B. Virginis	296	322	298
June 4	24 Sagittarii	85	88	85
5	53 Sagittarii	132	125	129
5	274 B. Sagittarii	132	125	129
6	17 Capricor.	80	70	81
July 21	ω Virginis	283	307	284
Aug. 26	208 B. Sagittarii	253	249	251
Sept. 1	f Piscium	68	46	70
30	31 Arietis	108	85	107
Oct. 24	351 B. Aquarii	202	173	197
Nov. 17	36 B. Capricor.	246	233	244
20	ψ^3 Aquarii	263	239	262
Dec. 1	79 Cancri	169	177	164
23	53 Tauri	324	313	328
1891, Feb. 20	λ Cancri	305	318	308
21	90 H^1. Cancri	283	298	284
Mar. 15	56 Tauri	330	320	335
19	ω^1 Cancri	196	201	191
19	ω^2 Cancri	276	285	277
May 4	54 B. Ceti	92	66	92
14	ξ Cancri	284	300	285
14	79 Cancri	271	285	271
28	φ Capricor.	132	114	129
July 18	157 B. Ophiuchi	276	287	277
18	Pi. XVII 31	322	336	326
18	39 Ophiuchi	323	337	327
22	ε Capricor.	38	25	42
Aug. 14	22 Ophiuchi	282	295	283
18	χ Capricor.	267	253	267
20	ψ^1 Aquarii	134	107	131
20	ψ^2 Aquarii	50	28	53
24	σ Arietis	10	353	15
Oct. 12	φ Capricor.	237	218	234
14	ψ^1 Aquarii	225	196	221
14	ψ^2 Aquarii	298	276	301
Nov. 6	σ Sagittarii	285	285	286
6	σ Sagittarii	100	82	99
19	υ Geminor.	121	125	119
1892, Feb. 23	σ Sagittarii	82	81	83
May 13	26 Ophiuchi	50	64	53
July 4	α Libræ	254	275	252
6	ρ Oph. (N).	295	311	297
6	ρ Oph. (S).	295	312	297
11	χ Capricor.	168	147	163
Aug. 3	88 B. Ophiuchi	208	214	203
Sept. 6	ψ^1 Aquarii	265	239	265
11	33 Tauri	145	124	141
Dec. 12	46 Virginis	104	130	103
1893, Mar. 25	ι Geminor.	285	293	286
Apr. 23	79 Cancri	289	309	291
May 8	ε Capricor.	60	42	62
June 24	28 G. Libræ	296	321	298
July 1	χ Capricor.	98	79	97
6	ζ Piscium	68	47	70
Aug. 2	171 B. Piscium	125	94	122
21	3 Sagittarii	258	261	257
Sept. 3	β Tauri	201	189	196
23	70 Aquarii	251	220	246
Oct. 20	50 Aquarii	265	235	260
26	23 Tauri	36	14	31
26	20 Tauri	139	117	134
Nov. 19	44 Piscium	288	254	283
24	β Tauri	292	280	287
24	β Tauri	81	70	76
Dec. 20	9 Tauri	322	299	327

*See note, page 119.

CAPE OF GOOD HOPE—Continued.

Date.	Star.	m*	m_1	m'	Date.	Star.	m	m_1	m'
		°	°	°			°	°	°
1893, Dec. 20	17 Tauri	280	258	275	1898, Feb. 13	42 Libræ	114	128	117
20	16 Tauri	239	219	236	25	θ Arietis	294	274	293
20	20 Tauri	231	211	228	Mar. 2	ε Geminor.	290	294	286
1894, Jan. 18	β Tauri	286	281	287	5	π Cancri	246	262	241
Feb. 28	10 G. Sagittarii	124	123	121	17	ρ Capricor.	127	114	132
Mar. 16	φ Geminor.	287	301	289	Apr. 25	139 Tauri	312	311	307
31	χ Capricor.	31	16	35	28	θ Cancri	326	339	321
Apr. 24	38 B. Sagittarii	63	66	65	May 16	75 Piscium	91	69	91
25	τ Sagittarii	104	97	103	June 6	50 Sagittarii	64	56	69
29	50 Aquarii	41	20	45	13	105 Piscium	128	106	127
29	182 B. Aquarii	24	2	28	30	42 Libræ	306	320	309
May 2	147 B. Piscium	51	25	54	Aug. 6	75 Piscium	10	347	9
21	10 G. Sagittarii	154	152	150	25	26 Ophiuchi	195	201	199
July 15	38 B. Sagittarii	315	320	319	Sept. 3	η Piscium	83	62	82
Aug. 4	β Virginis	293	324	295	23	ν^1 Sagittarii	288	283	293
Sept. 21	116 B. Aurigæ	30	30	34	23	ν^2 Sagittarii	289	284	294
Dec. 2	η Capricor.	254	233	253	Oct. 20	23 Sagittarii	213	211	218
1895, Jan. 20	α Scorpii	315	330	319	24	51 Aquarii	263	242	266
20	α Scorpii	62	75	64	Nov. 16	1 Sagittarii	276	275	280
Feb. 6	28 Geminor.	242	244	239	Dec. 30	o^1 Cancri	158	174	154
6	53 Aurigæ	292	298	294	1899, Feb. 2	43 H. Virginis	43	62	45
13	α Virginis	31	62	35	4	27 G. Scorpii	54	66	58
18	38 B. Sagittarii	86	85	86	21	79 Geminor.	282	291	276
Apr. 3	ω^1 Cancri	339	358	344	Mar. 16	26 Tauri	271	258	267
May 6	g Virginis	210	234	205	16	27 Tauri	212	200	208
July 30	48 B. Scorpii	286	299	287	May 1	31 B. Capricor.	97	83	101
1896, Jan. 7	ι Virginis	79	101	76	3	44 Aquarii	104	83	106
31	ρ Leonis	68	90	63	12	132 Tauri	230	228	225
Mar. 8	h Sagittarii	120	112	123	June 13	ο Leonis	224	243	221
Apr. 7	μ Capricor.	85	65	90	25	τ Capricor.	78	63	82
22	α Leonis	295	316	290	July 18	δ Scorpii	179	191	183
25	ψ Virginis	286	309	282	18	δ Scorpii	159	171	164
May 1	σ Sagittarii	222	218	226	Aug. 26	66 Arietis	149	135	145
1	σ Sagittarii	147	142	150	27	62 Tauri	118	108	113
20	ρ Leonis	307	328	302	Oct. 11	36 Sagittarii	254	249	259
26	α Scorpii	224	234	225	27	ο Leonis	92	110	89
26	α Scorpii	116	126	117	Nov. 11	187 B. Aquarii	248	226	249
June 19	ψ Virginis	307	330	304	13	36 Piscium	246	222	245
22	A Scorpii	272	284	272	14	75 Piscium	204	182	202
July 31	ι Arietis	109	89	111	18	99 Tauri	101	94	96
Aug. 20	4 Capricor.	274	262	278	Dec. 8	138 B. Aquarii	216	196	218
Sept. 5	α Leonis	218	239	213	13	μ Arietis	256	239	252
18	42 Capricor.	278	259	283	1900, Jan. 23	40 H. Virginis	139	159	143
Oct. 9	α Scorpii	246	255	247	Feb. 3	d Piscium	324	300	322
10	α Scorpii	130	140	132	12	90 B. Cancri	274	288	270
Nov. 9	χ Sagittarii	324	316	328	Mar. 7	300 B. Tauri	221	213	216
9	χ Sagittarii	7	359	11	8	394 B. Tauri	286	283	281
9	49 Sagittarii	194	186	198	23	14 Sagittarii	67	66	72
1897, Jan. 17	A Geminor.	337	344	332	26	ν Aquarii	113	97	116
23	χ Virginis	167	190	164	Apr. 2	τ Arietis	262	247	257
27	α Scorpii	333	342	335	5	η Geminor.	264	265	259
27	α Scorpii	46	55	48	May 16	52 Ophiuchi	74	77	79
Feb. 13	39 Geminor.	347	352	343	16	158 G. Ophiuchi	105	108	110
23	α Scorpii	83	92	85	16	58 Ophiuchi	129	131	134
Apr. 14	79 Leonis	282	306	278	20	19 Aquarii	100	83	102
19	σ Scorpii	68	78	70	June 8	550 B. Virginis	211	233	215
May 5	136 Tauri	244	243	240	14	45 Sagittarii	126	118	130
July 3	18 Leonis	337	356	332	July 6	40 H. Virginis	279	298	283
12	λ Sagittarii	210	208	214	10	58 Ophiuchi	247	250	252
Aug. 4	83 Virginis	255	276	255	Aug. 7	μ Sagittarii	264	264	269
Sept. 9	ρ Aquarii	306	285	310	8	d Sagittarii	287	280	291
18	136 Tauri	166	165	162	17	A Tauri	146	135	141
Oct. 1	A Ophiuchi	278	283	282	Sept. 1	ω^2 Scorpii	233	244	238
8	16 Piscium	217	194	220	2	116 B. Ophiuchi	257	262	262
Nov. 4	κ Piscium	260	237	264	4	171 B. Sagittarii	324	318	328
4	9 Piscium	301	278	304	28	λ Libræ	234	247	239
Dec. 5	θ Arietis	249	230	248	Nov. 13	h Leonis	24	42	23
13	π Cancri	77	94	72	26	g Sagittarii	251	240	254
1898, Jan. 10	18 Leonis	106	125	102	Dec. 5	67 Tauri	239	229	234
10	19 Leonis	88	107	83	9	23 H^1. Cancri	72	85	70

* See note, page 119.

CAPE OF GOOD HOPE—Continued.

Date.	Star.	m	m_1	m'	Date.	Star.	m	m_1	m'
		°	°	°			°	°	°
1901, Jan. 28	22 H^1. Tauri	242	229	237	1903, Dec. 31	68 Tauri	238	232	240
Feb. 15	ρ Sagittarii	94	86	97	1904, Mar. 4	l Virginis	129	151	134
25	247 B. Tauri	252	242	246	Apr. 22	2 B. Cancri	290	302	293
26	o Tauri	244	240	239	May 1	φ Ophiuchi	98	107	100
Mar. 10	28 Libræ	107	123	112	24	η Virginis	266	289	271
25	105 Tauri	252	246	247	June 4	ρ Aquarii	121	100	116
28	5 Cancri	233	244	231	July 7	38 Arietis	101	83	98
Apr. 4	α Virginis	287	308	291	18	38 Virginis	325	348	330
4	α Virginis	77	99	81	22	φ Ophiuchi	283	292	284
7	56 B. Scorpii	78	90	83	Sept. 13	13 Libræ	278	295	281
7	β Scorpii	78	89	83	22	67 Aquarii	303	281	298
10	89 G. Sagittarii	36	33	40	Oct. 27	m Tauri	124	118	124
24	f Geminor.	239	248	236	Dec. 16	77 Piscium	248	225	244
May 5	123 B. Scorpii	69	77	74	1905, Jan. 26	80 Virginis	72	93	76
June 5	g Sagittarii	91	79	93	Mar. 17	o^1 Cancri	247	263	252
12	19 Arietis	51	31	46	Apr. 16	σ Leonis	211	234	216
22	p^5 Leonis	336	1	341	24	ρ Sagittarii	112	105	109
25	α Virginis	296	315	298	May 10	ζ Cancri	245	257	249
25	α Virginis	78	97	80	10	Pi. VIII 6	245	257	249
July 10	ρ Arietis	101	88	100	July 7	σ Leonis	340	4	345
Aug. 9	ζ Tauri	108	105	104	20	337 B. Aquarii	134	111	129
19	86 Virginis	244	266	249	Aug. 7	15 Libræ	300	317	301
22	ν Scorpii	264	275	269	Sept. 12	λ Aquarii	226	204	221
30	κ Piscium	67	44	64	12	λ Aquarii	122	100	117
Sept. 25	30 Aquarii	315	295	314	Dec. 2	37 Aquarii	200	180	196
Oct. 21	16 B. Aquarii	304	288	304	10	64 Tauri	210	200	210
29	129 H^1. Tauri	114	105	109	1906, Mar. 3	m Tauri	335	329	338
Nov. 16	283 B. Sagittarii	212	203	214	4	57 Orionis	244	244	247
Dec. 18	19 Piscium	260	237	256	17	Y Sagittarii	152	150	148
22	175 B. Arietis	244	229	239	20	29 Capricor.	86	69	81
1902, Jan. 18	53 Arietis	232	216	227	Apr. 2	61 Geminor.	198	206	202
19	43 Tauri	344	332	339	10	18 Libræ	107	124	107
31	ν Libræ	92	108	97	14	190 B. Sagittarii	121	115	117
Feb. 17	χ^1 Orionis	283	282	280	May 9	φ Ophiuchi	114	123	112
Mar. 20	h Leonis	290	308	291	17	4 Ceti	133	109	129
25	h Virginis	68	89	73	June 4	18 Libræ	255	271	255
28	73 B. Scorpii	69	81	74	July 8	μ Capricor.	104	85	100
29	29 Ophiuchi	154	160	158	Aug. 9	ν Piscium	61	40	60
May 10	57 Orionis	308	307	306	Sept. 5	f Piscium	136	114	134
12	1 Cancri	342	352	341	Oct. 28	27 Piscium	230	206	226
June 10	h Leonis	299	318	301	Dec. 19	45 Capricor.	274	255	269
17	32 Libræ	245	259	250	1907, Jan. 27	63 Geminor.	246	254	251
July 11	261 B. Virginis	295	318	300	Feb. 1	ν Virginis	103	126	106
11	f Virginis	295	319	300	16	f Piscium	260	238	259
18	100 B. Sagittarii	274	271	276	21	351 B. Tauri	295	290	298
Nov. 6	283 B. Sagittarii	244	234	244	25	139 B. Cancri	311	326	316
17	57 Orionis	120	119	118	Mar. 10	19 Capricor.	83	67	78
1903, Feb. 7	352 B. Tauri	248	244	246	Apr. 25	c Virginis	316	340	318
19	24 Scorpii	88	96	91	June 18	ν Virginis	317	340	320
Mar. 5	173 B. Tauri	346	334	342	July 23	33 Sagittarii	242	237	237
Apr. 4	74 B. Geminor.	318	322	317	23	π Sagittarii	247	241	242
Aug. 1	η Libræ	259	272	263	26	39 Aquarii	55	34	51
Sept. 2	54 Sagittarii	323	314	322	Sept. 15	30 G. Sagittarii	293	293	288
2	e Sagittarii	299	290	298	16	o Sagittarii	283	277	278
Oct. 22	γ Libræ	218	231	221	19	39 Aquarii	288	267	284
Dec. 31	119 H^1. Tauri	285	276	283	19	45 Aquarii	268	248	265

COBHAM.

1902, Oct. 22	λ Geminor.	124	131	124	1904, Sept. 29	γ Tauri	124	114	123
Nov. 20	60 Cancri	96	111	97	29	θ^1 Tauri	82	72	81
1903, Jan. 14	α Cancri	111	126	112	29	θ^2 Tauri	61	51	59
Mar. 8	51 Geminor.	327	334	327	Nov. 20	64 Ceti	297	277	294
June 2	p^4 Leonis	295	317	299	20	ξ^1 Ceti	274	254	271
Oct. 30	ρ Aquarii	204	183	199	Dec. 20	γ Tauri	100	90	100
1904, July 9	θ^1 Tauri	80	70	78	20	75 Tauri	233	223	232

CRACOW.

Date.	Star.	m	m_1	m'	Date.	Star.	m	m_1	m'
		°	°	°			°	°	°
1825, Dec. 14	c^1 Capricor.	306	288	311	1839, Oct. 19	φ Aquarii	286	264	286
1827, July 2	49 Virginis	300	322	298	19	96 Aquarii	290	267	291
Aug. 1	41 Libræ	296	309	296	Nov. 14	ι Aquarii	262	243	267
29	58 G. Scorpii	304	314	309	1840, Jan. 13	μ Arietis	322	305	325
1828, Feb. 22	68 Tauri	296	286	293	14	q Tauri	313	301	314
June 16	κ Cancri	272	288	267	14	21 Tauri	300	288	301
1829, Apr. 12	α Cancri	311	326	307	14	22 Tauri	308	296	309
June 13	μ Libræ	300	317	304	16	406 B. Tauri	255	253	253
Dec. 9	α Tauri	269	260	264	Apr. 11	ν Leonis	318	337	313
1830, Mar. 2	130 Tauri	237	235	232	Sept. 3	τ Scorpii	284	292	285
3	26 Geminor.	237	240	232	1841, Feb. 27	7 Tauri	212	199	211
Apr. 28	1 Cancri	297	307	294	Apr. 28	π Cancri	325	341	320
May 1	48 Leonis	246	267	245	Sept. 22	66 B. Sagittarii	216	215	220
June 4	η Libræ	232	245	237	1842, Mar. 22	o^2 Cancri	257	272	252
25	o Sextantis	291	312	290	22	o^1 Cancri	314	329	309
July 16	α Tauri	222	213	216	May 14	63 Geminor.	290	297	285
Aug. 1	110 B. Sagittarii	248	246	246	1843, Mar. 6	47 Arietis	272	256	269
Oct. 20	24 Scorpii	228	236	233	May 3	1 Geminor.	269	269	263
23	d Sagittarii	272	266	276	3	3 Geminor.	236	236	231
Dec. 22	29 Piscium	305	282	303	3	4 Geminor.	257	257	252
1831, Jan. 20	ν Piscium	290	269	286	9	e Leonis	221	244	219
22	f Tauri	335	321	330	June 3	h Leonis	247	264	244
Feb. 19	48 Tauri	272	261	267	Nov. 2	κ Piscium	253	230	254
19	γ Tauri	255	244	250	2	9 Piscium	290	267	291
June 21	γ Libræ	233	247	239	1844, Apr. 26	ω Leonis	284	301	281
Oct. 23	α Tauri	307	298	302	1845, Jan. 12	κ Piscium	257	234	256
23	α Tauri	46	37	41	12	9 Piscium	293	270	291
Dec. 17	γ Tauri	284	274	279	Apr. 12	68 Orionis	267	267	263
1832, Jan. 5	θ Capricor.	269	254	269	May 20	25 Libræ	296	311	301
Feb. 10	α Tauri	294	285	289	Sept. 13	c^1 Capricor.	278	260	278
10	α Tauri	53	44	48	Nov. 6	ν Aquarii	223	207	223
15	α Leonis	267	286	269	9	22 Piscium	269	246	266
Mar. 8	75 Tauri	285	275	280	1846, May 4	14 Sextantis	258	278	260
9	119 Tauri	273	269	269	1848, Feb. 15	λ Geminor.	302	309	304
Sept. 4	o Sagittarii	294	289	296	May 9	35 Leonis	192	208	195
Dec. 31	311 B. Piscium	283	262	283	1849, Jan. 3	64 Ceti	270	250	267
1833, Mar. 31	8 Leonis	207	224	210	3	ξ^2 Ceti	250	231	246
1834, Apr. 13	330 B. Tauri	217	211	222	Apr. 5	β Virginis	251	274	256
20	ν Virginis	224	247	229	Oct. 25	73 B. Aquarii	249	232	244
Oct. 7	33 Scorpii	296	300	296	1850, Apr. 15	264 B. Tauri	311	301	312
7	44 Ophiuchi	274	278	274	15	α Tauri	267	258	269
8	λ Sagittarii	271	269	270	16	120 Tauri	215	212	217
Nov. 3	24 Ophiuchi	268	275	268	21	ρ Leonis	318	339	323
1835, Jan. 6	35 Ceti	225	203	228	22	σ Leonis	243	266	248
Apr. 9	46 Leonis	256	276	261	Aug. 14	γ Libræ	263	277	262
June 10	θ Ophiuchi	254	258	253	1851, Jan. 15	64 Orionis	261	260	265
July 6	λ Libræ	228	240	228	Mar. 13	d^1 Cancri	302	314	307
Aug. 29	26 Libræ	289	304	290	Aug. 2	80 Virginis	285	306	285
Oct. 3	69 Aquarii	255	234	250	Sept. 4	28 Sagittarii	282	278	277
Nov. 25	35 Capricor.	271	255	266	Dec. 5	87 Ceti	301	283	302
1836, Feb. 23	14 Tauri	248	235	253	1852, Jan. 4	i Tauri	224	217	228
25	118 Tauri	280	276	283	6	d Geminor.	236	240	241
Mar. 24	139 Tauri	317	316	320	Mar. 30	98 B. Cancri	317	330	322
Apr. 25	η Leonis	208	227	213	30	102 B. Cancri	279	292	284
1837, Feb. 14	112 B. Aurigæ	230	227	234	30	107 B. Cancri	289	302	293
Mar. 15	47 Geminor.	286	288	291	Apr. 25	δ Geminor.	334	341	339
16	ω Cancri	276	286	281	27	83 Cancri	323	339	327
May 10	λ Cancri	310	321	315	28	37 Leonis	327	347	330
June 6	4 Cancri	238	248	239	Aug. 25	49 Sagittarii	289	282	284
Nov. 10	54 Ceti	306	285	307	Sept. 18	ν Scorpii	281	292	276
1838, Jan. 3	88 Piscium	274	252	274	Oct. 24	30 Piscium	225	202	225
Feb. 4	107 B. Aurigæ	270	267	273	1853, Feb. 18	1 Geminor.	251	251	256
Mar. 1	τ Arietis	315	301	318	May 12	42 Geminor.	237	242	242
June 4	40 H. Virginis	333	352	328	20	95 Virginis	239	259	236
Sept. 2	κ Capricor.	295	278	292	July 17	157 B. Ophiuchi	286	291	281
Oct. 25	A Sagittarii	215	205	210	1854, Jan. 7	ξ Arietis	287	268	291
Nov. 27	171 B. Piscium	301	278	306	Mar. 3	31 Arietis	291	273	296
Dec. 26	27 Arietis	246	228	250	July 7	18 Ophiuchi	304	311	299
1839, July 23	W Sagittarii	320	320	321	31	m Virginis	316	337	312
Aug. 25	φ Aquarii	270	248	270	Sept. 30	ω Sagittarii	272	263	270
Oct. 18	58 Aquarii	255	234	254	30	A Sagittarii	291	281	289

DORCHESTER, MASS.

Date.	Star.	m	m_1	m'
		°	°	°
1825, July 27	o Sagittarii	321	316	326
27	o Sagittarii	34	29	39
27	π Sagittarii	206	201	210
1827, Feb. 10	α Cancri	215	230	214
Nov. 16	α Virginis	249	271	254
28	ε Piscium	277	255	272
1828, Jan. 31	60 Cancri	222	237	223
Aug. 16	λ Virginis	293	312	299
1829, Aug. 21	α Tauri	247	238	245
21	α Tauri	106	97	104
Sept. 17	α Tauri	286	277	284
23	o Leonis	321	339	325
23	o Leonis	26	44	30
Nov. 11	α Tauri	326	317	325
11	α Tauri	46	37	44
1830, Jan. 5	α Tauri	315	306	313
Mar. 28	α Tauri	252	243	251
28	α Tauri	109	100	108
July 15	α Tauri	216	207	216
Oct. 4	f Tauri	333	319	331
4	f Tauri	19	5	17
1831, Jan. 21	μ Ceti	314	296	312
Feb. 4	γ Libræ	297	311	298
4	γ Libræ	76	90	77
19	θ^1 Tauri	289	279	289
19	θ^2 Tauri	312	302	313
1831, Feb 19	α Tauri	207	198	207
Aug. 28	f Tauri	308	294	308
29	γ Tauri	230	220	231
29	γ Tauri	116	106	117
29	α Tauri	273	264	275
29	θ^1 Tauri	300	290	302
29	θ^2 Tauri	338	328	339
29	θ^2 Tauri	7	357	8
Oct. 14	π Capricor.	242	230	237
23	α Tauri	244	235	245
23	α Tauri	104	95	106
1832, June 17	∂ Capricor.	332	314	327
17	∂ Capricor.	29	11	24
Sept. 7	∂ Capricor.	308	290	304
7	∂ Capricor.	53	35	48
1839, Apr. 20	γ Cancri	307	320	304
June 19	28 Virginis	357	20	352
20	68 Virginis	244	265	240
23	b Scorpii	265	277	263
July 1	φ Aquarii	243	221	249
1	φ Aquarii	88	66	93
Nov. 20	17 Tauri	256	244	258
20	20 Tauri	224	212	225
20	η Tauri	312	300	314
Dec. 12	λ Aquarii	251	263	256

DORPAT.

Date.	Star.	m	m_1	m'
1812, Oct. 21	f Tauri	300	286	300
21	f Tauri	52	38	51
Dec. 16	γ Tauri	242	232	242
16	γ Tauri	109	99	110
16	θ^2 Tauri	312	302	312
16	264 B. Tauri	266	256	267
16	α Tauri	260	251	261
1813, Apr. 8	ζ Cancri	262	273	267
8	ζ Cancri	95	106	100
10	ν Leonis	258	277	263
10	ν Leonis	99	118	104
1814, Feb. 1	ν Geminor.	263	265	267
1816, Apr. 12	κ Virginis	258	277	255
1819, Sept. 8	ζ Arietis	230	215	235
Oct. 9	49 Aurigæ	269	271	270
1820, Apr. 23	χ Leonis	210	232	205
Aug. 28	47 Arietis	241	225	244
28	47 Arietis	98	82	101
1821, Feb. 6	62 Piscium	261	238	266
6	∂ Piscium	212	189	216
6	∂ Piscium	38	15	43
May 6	κ Geminor.	272	280	269
July 22	μ Arietis	228	211	230
23	16 Tauri	265	252	266
23	17 Tauri	305	292	306
23	q Tauri	235	223	236
23	20 Tauri	266	254	267
23	21 Tauri	228	216	229
23	17 Tauri	41	28	42
23	16 Tauri	81	69	82
23	20 Tauri	79	67	80
Dec. 7	q Tauri	258	266	258
7	17 Tauri	349	337	349
7	17 Tauri	2	350	2
7	21 Tauri	251	239	251
7	q Tauri	94	82	94
1822, Feb. 8	υ Leonis	289	312	284
8	υ Leonis	94	117	90
1822, Feb. 27	q Tauri	340	328	339
27	21 Tauri	319	307	318
27	q Tauri	24	12	24
May 1	υ Leonis	210	233	205
1	υ Leonis	175	198	171
Aug. 10	17 Tauri	71	58	70
10	16 Tauri	109	96	108
10	20 Tauri	243	231	242
10	q Tauri	153	141	152
10	η Tauri	330	318	329
10	22 Tauri	157	145	156
10	20 Tauri	112	100	111
10	η Tauri	23	11	22
Oct. 31	23 Tauri	276	264	275
31	η Tauri	261	249	260
31	23 Tauri	75	63	74
31	27 Tauri	295	283	294
31	η Tauri	90	78	89
31	27 Tauri	55	43	54
Nov. 30	ε Geminor.	267	270	262
Dec. 25	17 Tauri	263	250	261
25	16 Tauri	223	210	222
25	20 Tauri	222	210	220
25	η Tauri	303	291	301
25	η Tauri	48	36	47
25	28 Tauri	330	318	328
1823, Jan. 24	ε Geminor.	277	280	273
24	ε Geminor.	91	94	87
Sept. 23	μ Arietis	103	86	102
1824, Sept. 4	ρ Capricor.	306	294	311
1825, Jan. 3	1 Geminor.	228	227	223
Feb. 27	η Geminor.	251	251	246
Mar. 24	A Tauri	285	274	280
24	39 Tauri	302	291	297
Sept. 23	c^2 Capricor.	246	228	247
1826, Feb. 15	53 Tauri	298	288	293
16	105 Tauri	280	274	275

ENGELHARDT (NEAR KASAN).

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1904, Feb. 29	ο Leonis	261	280	266	1904, Dec. 20	θ^2 Tauri	36	27	36
29	ο Leonis	100	119	104	1905, Apr. 12	162 B. Geminor.	286	295	290
Mar. 22	γ Tauri	334	324	332	12	162 B. Geminor.	76	85	80
27	209 B. Cancri	24	40	27	July 13	29 Ophiuchi	316	332	314
Apr. 28	m Virginis	219	240	223	Oct. 11	5 Ceti	188	164	183
Dec. 20	48 Tauri	308	297	307	11	5 Ceti	159	144	154
20	γ Tauri	310	300	310	1906, Dec. 25	ξ^2 Ceti	229	210	230
20	θ^1 Tauri	302	293	302	1907, Mar. 21	B. D.+19° 1110	305	304	310
20	θ^2 Tauri	331	322	331	Sept. 18	η Capricor.	18	2	14

EVANSTON.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
1897, Aug. 9	χ Sagittarii	296	290	301	1898, Feb. 5	o^2 Cancri	278	294	273
14	λ Piscium	224	201	228	25	26 Arietis	272	253	270
Oct. 3	53 Sagittarii	263	254	268	Apr. 2	10 Sextantis	303	323	299
30	49 Sagittarii	314	306	319	1900, Sept. 12	44 Arietis	110	92	105
Dec. 5	26 Arietis	209	190	208	1901, Oct. 19	ρ Sagittarii	241	234	244
25	o Capricor.	176	163	182	24	λ Piscium	222	199	219
27	θ Aquarii	199	178	203	Dec. 19	62 Piscium	303	280	299
1898, Jan. 5	125 Tauri	240	237	236	21	o Arietis	315	297	310
26	45 Piscium	322	299	324					

GÖTTINGEN.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
1868, Feb. 29	f Tauri	336	322	335	1891, Feb. 12	29 Ceti	293	272	296
Mar. 1	θ^1 Tauri	257	247	257	Apr. 20	ν Virginis	256	279	255
1	θ^2 Tauri	277	267	277	25	41 Libræ	85	98	80
1	264 B. Tauri	214	204	214	25	κ Libræ	305	318	300
1	85 Tauri	307	297	306	25	κ Libræ	84	97	79
Sept. 8	α Tauri	222	212	222	May 10	121 Tauri	312	309	317
8	α Tauri	134	124	134	Oct. 15	30 Piscium	325	301	327
1869, Aug. 2	α Tauri	65	56	67	15	30 Piscium	25	1	27
Dec. 8	δ Capricor.	239	220	234	Nov. 7	ω Sagittarii	283	273	280
1870, Feb. 10	m Tauri	322	316	325	10	τ Aquarii	201	179	202
1877, Nov. 20	17 Tauri	23	10	23	10	τ Aquarii	138	116	139
20	q Tauri	244	231	245	1892, Jan. 19	γ Virginis	309	332	305
20	20 Tauri	276	263	277	May 8	θ Virginis	298	320	294
20	20 Tauri	67	54	67	8	θ Virginis	82	104	78
22	136 Tauri	198	196	195	Oct. 3	τ Aquarii	294	272	296
1887, Mar. 8	ρ Leonis	243	264	248	31	ψ^3 Aquarii	200	177	203
8	ρ Leonis	116	137	121	1893, Sept. 1	δ Arietis	148	132	152
1889, Jan. 12	64 Tauri	239	229	243	1894, Mar. 14	136 Tauri	338	337	339
1890, Jan. 3	l Tauri	330	324	335	Apr. 12	c Geminor.	271	280	270
Feb. 7	ν Virginis	269	292	270	1895, June 26	α Leonis	298	318	293
7	ν Virginis	103	126	104	26	α Leonis	80	100	75
14	4 Sagittarii	157	158	152	Sept. 29	δ Capricor.	263	244	268
14	7 Sagittarii	303	303	298	30	σ Aquarii	197	176	202
June 29	β Scorpii	92	104	87	Nov. 27	62 Piscium	290	267	294
July 12	ε Tauri	25	15	30	27	δ Piscium	249	226	253

GREENWICH.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
1753, Apr. 19	β Scorpii	317	329	321	1764, Feb. 20	α Virginis	113	135	108
Aug. 5	8 Libræ	182	199	188	1765, Feb. 4	γ Cancri	270	283	266
Oct. 5	16 B. Capricor.	235	223	235	4	γ Cancri	102	115	98
5	β Capricor.	239	227	239	Sept. 25	δ Capricor.	277	259	282
5	β Capricor.	108	96	108	Oct. 2	q Tauri	294	281	295
1754, Apr. 2	κ Cancri	268	283	270	2	18 Tauri	206	193	207
Nov. 21	ρ Aquarii	278	268	274	1766, Sept. 22	17 Tauri	330	317	329
1755, July 18	θ Libræ	311	324	313	22	20 Tauri	279	266	279
17[illegible]7, Feb. 25	α Tauri	118	109	120	1767, Sept. 12	η Tauri	285	272	283
Apr. 3	γ Virginis	316	339	320	12	27 Tauri	327	315	324
3	γ Virginis	53	76	56	12	η Tauri	70	58	68
July 30	19 Capricor.	283	269	278	1768, Jan. 27	23 Tauri	251	238	248
1758, Feb. 17	ν Geminor.	243	244	247	27	η Tauri	197	185	194
1761, Dec. 10	θ^2 Tauri	318	308	318	27	η Tauri	182	170	179
1764, Feb. 20	α Virginis	276	298	271	1769, Sept. 15	16 Piscium	235	212	235

GREENWICH—Continued.

Date.	Star.	m	m₁	m′
		°	°	°
1769, Sept. 20	67 Tauri	254	244	249
20	κ Tauri	231	221	226
20	67 Tauri	127	117	122
20	κ Tauri	105	95	100
25	h Leonis	226	243	222
Nov. 18	α Cancri	28	43	25
1770, Apr. 7	e Leonis	260	283	261
28	ζ Tauri	276	272	271
July 19	ζ Tauri	108	104	103
1771, July 4	δ Piscium	246	223	241
4	δ Piscium	116	93	112
Sept. 18	β Capricor.	228	216	229
Dec. 24	κ Cancri	90	105	90
1772, May 15	8 Libræ	239	256	244
15	α Libræ	246	263	251
Aug. 17	ζ Piscium	130	108	124
Sept. 7	β Capricor.	232	220	231
1773, Feb. 6	α Cancri	282	297	284
Sept. 7	α Tauri	319	310	317
Nov. 1	α Tauri	296	287	294
1774, Nov. 18	α Tauri	96	87	96
1775, Aug. 1	γ Virginis	112	135	116
Dec. 12	α Leonis	117	136	123
1776, Jan. 29	α Tauri	272	263	274
Mar. 30	α Leonis	240	259	245
Apr. 6	γ Libræ	212	226	211
1777, Nov. 16	ζ Tauri	270	267	275
16	ζ Tauri	68	65	73
1778, Feb. 7	μ Geminor.	219	220	224
Dec. 31	ι Tauri	235	229	241
1779, Feb. 27	γ Cancri	254	267	258
Oct. 30	1 Geminor.	52	60	55
Dec. 22	132 Tauri	312	310	316
1783, Feb. 9	q Tauri	219	206	222
9	19 Tauri	217	204	220
May 16	π Scorpii	270	282	267
Oct. 7	φ Aquarii	312	290	317
Dec. 6	17 Tauri	297	284	298
6	q Tauri	197	184	195
30	δ Piscium	236	213	241
30	δ Piscium	103	80	107
1784, July 2	τ Sagittarii	305	300	308
1785, Apr. 11	q Tauri	259	247	259
11	17 Tauri	354	341	353
11	20 Tauri	284	271	283
11	21 Tauri	242	229	241
11	22 Tauri	250	237	249
June 22	φ Sagittarii	261	258	265
Aug. 16	φ Sagittarii	97	94	102
1786, Mar. 5	17 Tauri	295	282	293
5	16 Tauri	257	244	255
5	q Tauri	213	200	211
5	20 Tauri	249	236	246
Nov. 12	π Leonis	294	313	290
12	π Leonis	91	110	87
Dec. 9	ξ Leonis	219	236	215
9	ξ Leonis	147	164	143
1787, Nov. 26	η Geminor.	279	279	274
26	η Geminor.	88	88	83
26	μ Geminor.	203	204	198
26	μ Geminor.	177	178	172
1788, Oct. 18	i Tauri	297	291	292
18	i Tauri	61	55	56
Nov. 15	ζ Tauri	349	326	324
15	ζ Tauri	30	27	25
1789, Nov. 9	κ Cancri	140	155	139
1790. Mar. 5	κ Libræ	321	334	326
Aug. 17	ν Scorpii	216	227	221
Oct. 15	β Capricor.	223	211	223
Nov. 17	ε Piscium	257	234	252
1791, Mar. 16	κ Cancri	262	277	263
Apr. 7	δ Tauri	253	243	249
June 12	λ Virginis	224	243	229
1792, Mar. 27	α Tauri	325	316	322
1793, Apr. 16	ξ Leonis	329	346	333
1794, Mar. 5	μ Ceti	277	259	276
7	α Tauri	214	205	215
Aug. 4	γ Libræ	268	282	268
Nov. 8	α Tauri	67	58	69
Dec. 18	γ Libræ	100	114	99
1795, May 4	η Libræ	137	150	135
July 25	η Libræ	249	262	247
Aug. 6	ξ^2 Ceti	196	177	197
28	γ Capricor.	257	240	253
Oct. 6	δ Cancri	52	65	57
Nov. 24	μ Ceti	243	225	244
1796, Aug. 20	33 Piscium	105	82	104
1797, Dec. 25	33 Piscium	243	220	244
1798, Aug. 8	ε Geminor.	65	68	69
1799, Apr. 10	125 Tauri	273	270	277
21	δ Scorpii	106	118	101
1800, May 5	η Virginis	322	345	318
July 4	43 Ophiuchi	235	239	232
Nov. 26	ζ Piscium	215	193	220
1801, Jan. 5	β Virginis	322	345	318
5	β Virginis	64	87	60
Mar. 30	α Virginis	297	319	292
30	α Virginis	87	109	82
Apr. 24	σ Leonis	246	268	241
May 24	α Virginis	300	322	295
Oct. 23	24 Tauri	231	219	234
23	η Tauri	237	225	240
23	23 Tauri	92	80	95
23	27 Tauri	282	270	285
23	28 Tauri	265	253	268
23	27 Tauri	60	48	62
23	28 Tauri	77	65	80
1802, Mar. 14	γ Cancri	280	293	276
Nov. 3	γ Capricor.	132	115	137
3	δ Capricor.	299	281	304
1803, Mar. 3	κ Geminor.	293	301	289
3	κ Geminor.	74	82	70
1804, July 17	π Scorpii	213	224	213
Dec. 14	η Tauri	252	240	250
14	27 Tauri	270	258	267
14	28 Tauri	252	240	249
1805, Aug. 6	λ Sagittarii	280	278	285
Sept. 7	θ Aquarii	276	256	279
7	θ Aquarii	66	46	70
1807, Dec. 14	ζ Tauri	226	223	222
14	ζ Tauri	121	118	116
1808, Oct. 31	δ Piscium	245	222	240
1809, Feb. 27	60 Cancri	250	265	250
Apr. 3	γ Scorpii	257	268	261
3	γ Scorpii	99	110	104
May 28	γ Scorpii	101	112	106
Sept. 28	64 Tauri	99	89	95
Dec. 15	ζ Piscium	308	286	303
1810, Jan. 15	δ Tauri	243	233	239
15	64 Tauri	269	259	265
1811, Mar. 1	α Tauri	268	259	266
1	α Tauri	99	90	97
1812, Dec. 14	μ Ceti	288	270	287
1813, Mar. 6	μ Ceti	250	232	249
Apr. 17	γ Libræ	261	275	260
17	γ Libræ	115	129	115
Aug. 13	ψ^1 Aquarii	37	15	33
Sept. 14	27 Tauri	66	52	67
1814, Oct. 1	μ Ceti	286	268	288
1	μ Ceti	57	39	59

GREENWICH—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1827, Jan. 14	κ Cancri	293	309	292	1851, Apr. 6	*m* Tauri	275	270	275
14	κ Cancri	70	86	69	Sept. 14	μ Ceti	110	94	113
19	*i* Virginis	30	51	35	1852, Feb. 3	63 Geminor.	268	276	273
Dec. 8	ω Leonis	272	289	273	11	30 Libræ	47	62	44
8	ω Leonis	100	117	101	Oct. 24	30 Piscium	211	188	211
1828, Mar. 23	26 Geminor.	256	259	254	24	33 Piscium	245	222	245
24	68 Geminor.	277	285	276	1853, Mar. 26	κ Virginis	88	108	84
1830, Jan. 5	α Tauri	257	248	256	28	β Scorpii	294	305	289
Mar. 28	θ^1 Tauri	290	280	288	May 20	95 Virginis	265	285	261
28	θ^2 Tauri	312	302	311	22	β Scorpii	123	135	119
28	264 B. Tauri	249	240	248	Aug. 29	48 Geminor.	84	90	89
28	85 Tauri	339	330	338	Sept. 20	38 Arietis	62	44	66
29	117 Tauri	312	308	312	Oct. 14	33 Piscium	289	266	290
Apr. 5	τ Leonis	270	293	276	1854, May 6	*i* Leonis	312	334	312
Oct. 5	θ^1 Tauri	263	253	262	Sept. 19	*i* Leonis	87	108	86
5	θ^2 Tauri	282	272	282	30	ω Sagittarii	262	252	260
5	85 Tauri	332	322	331	30	ω Sagittarii	98	88	96
1831, Jan. 26	*f* Geminor.	241	250	244	30	*A* Sagittarii	270	260	268
Feb. 19	48 Tauri	263	252	263	Oct. 11	139 Tauri	65	64	69
20	111 Tauri	312	308	314	Dec. 10	*i* Leonis	105	126	104
May 22	*l* Virginis	301	323	304	1855, Apr. 7	*X* Sagittarii	107	109	103
June 21	γ Libræ	247	233	247	23	λ Cancri	295	308	296
July 31	ξ^2 Ceti	107	88	105	Aug. 30	*o* Piscium	262	240	267
Oct. 21	ξ^2 Ceti	301	282	299	30	*o* Piscium	71	50	76
21	ξ^2 Ceti	51	32	50	Oct. 24	*o* Piscium	301	280	306
23	θ^1 Tauri	298	288	300	1856, Jan. 12	29 Piscium	198	174	202
23	θ^2 Tauri	329	319	330	Mar. 13	136 Tauri	272	270	274
23	75 Tauri	207	197	209	26	α Scorpii	289	299	286
23	θ^1 Tauri	48	38	50	Sept. 20	136 Tauri	332	330	334
23	75 Tauri	138	128	140	1857, Apr. 2	λ Cancri	252	265	250
23	99 Tauri	68	58	70	May 6	α Virginis	314	336	309
23	α Tauri	286	277	288	6	α Virginis	73	95	68
23	α Tauri	61	52	63	27	γ Cancri	340	354	337
Nov. 16	33 Ceti	224	201	221	Oct. 6	27 Tauri	219	206	222
24	π Cancri	8	24	13	6	27 Tauri	125	112	127
Dec. 18	119 Tauri	245	241	248	26	χ Capricor.	266	250	270
1847, Jan. 25	180 B. Tauri	232	221	229	28	70 Aquarii	300	278	305
Mar. 24	λ Geminor.	223	230	223	Nov. 27	ε Piscium	314	292	319
24	λ Geminor.	148	155	148	1858, Feb. 20	20 Tauri	291	277	293
26	κ Cancri	266	282	267	Apr. 25	28 Virginis	283	306	278
Apr. 22	A^2 Cancri	242	257	244	May 18	83 Cancri	203	220	199
May 23	υ Leonis	270	294	275	19	α Leonis	154	174	149
June 1	ρ Sagittarii	100	93	100	Aug. 30	*q* Tauri	273	259	274
1848, Jan. 16	α Tauri	45	36	43	30	*q* Tauri	69	55	70
May 7	68 Geminor.	321	330	323	30	20 Tauri	309	296	310
June 6	10 Sextantis	69	88	73	30	16 Tauri	37	24	38
July 11	θ Libræ	339	351	340	Nov. 22	136 Tauri	91	89	89
Aug. 21	γ Tauri	105	94	104	1859, Apr. 13	37 Sextantis	231	253	226
Sept. 15	ξ^1 Ceti	44	24	40	Sept. 21	μ Cancri	67	78	62
1849, Jan. 5	θ^1 Tauri	296	286	295	Dec. 8	23 Tauri	305	292	304
5	θ^2 Tauri	319	309	318	8	23 Tauri	46	33	45
5	264 B. Tauri	253	244	253	8	28 Tauri	310	297	309
5	θ^1 Tauri	75	65	74	8	27 Tauri	354	341	353
5	269 B. Tauri	264	254	263	8	17 Tauri	104	91	103
Feb. 27	85 Ceti	226	208	224	8	η Tauri	287	274	286
Mar. 29	111 Tauri	284	280	285	1860, Jan. 4	17 Tauri	325	312	324
29	111 Tauri	71	77	72	4	*q* Tauri	242	228	240
July 12	*f* Piscium	134	112	130	4	20 Tauri	256	243	255
Sept. 5	ν Piscium	217	196	214	Feb. 28	*q* Tauri	290	277	288
5	ν Piscium	140	118	137	28	16 Tauri	338	325	336
1850, Jan. 23	α Tauri	213	204	214	28	22 Tauri	281	268	280
23	α Tauri	152	143	153	28	20 Tauri	316	306	318
Mar. 23	o^1 Cancri	267	282	272	Mar. 4	δ Cancri	247	261	242
June 1	42 Aquarii	88	68	83	5	18 Leonis	263	282	258
Aug. 14	γ Libræ	260	274	259	Sept. 6	η Tauri	105	91	102
Dec. 17	75 Tauri	272	262	275	6	27 Tauri	66	52	63
1851, Jan. 15	64 Orionis	240	239	244	6	28 Tauri	83	70	81
15	68 Orionis	283	283	287	1861, Mar. 19	5 Geminor.	318	318	313
Mar. 13	d^1 Cancri	346	359	352	June 25	18 Aquarii	202	184	206
13	θ Cancri	276	273	282	Sept. 14	π Capricor.	285	272	289

GREENWICH—Continued.

Date.	Star.	m	m_1	m'	Date.	Star.	m	m_1	m'
		°	°	°			°	°	°
1861, Sept. 14	ρ Capricor.	238	225	242	1872, July 22	69 Aquarii	84	63	85
Oct. 20	ζ Arietis	281	265	278	Aug. 15	σ Sagittarii	126	122	122
22	103 Tauri	264	258	259	Sept. 15	69 Aquarii	282	263	285
1862, Mar. 9	6 Geminor.	295	295	289	15	τ Aquarii	249	228	250
Apr. 15	43 B. Libræ	85	101	88	24	ε Geminor.	274	277	278
July 15	κ Piscium	115	92	115	24	ε Geminor.	63	66	67
21	υ Tauri	121	112	118	Oct. 11	35 Capricor.	332	316	332
Sept. 3	π Sagittarii	185	179	190	14	33 Piscium	283	260	285
Oct. 11	κ Tauri	256	247	253	Dec. 9	f Piscium	212	190	216
11	κ Tauri	104	96	100	1873, May 1	39 Geminor.	276	280	279
Dec. 10	α Cancri	311	326	307	July 4	λ Virginis	318	337	312
10	α Cancri	73	88	69	Aug. 9	τ Aquarii	242	220	244
1863, Jan. 27	δ Arietis	251	236	247	Oct. 3	τ Aquarii	239	218	242
27	δ Arietis	104	89	100	13	λ Cancri	44	55	44
Mar. 2	α Cancri	300	316	297	Dec. 1	o Arietis	237	220	243
Apr. 26	κ Cancri	286	302	284	24	τ Aquarii	295	274	298
26	κ Cancri	93	109	90	24	τ Aquarii	41	20	45
July 28	36 Sagittarii	245	240	249	1874, Jan. 25	53 Arietis	233	218	239
Oct. 23	16 Piscium	211	188	208	27	k Tauri	271	265	276
30	χ^1 Orionis	277	275	273	30	c Geminor.	222	230	222
30	χ^1 Orionis	80	79	76	Mar. 26	λ Cancri	323	335	322
1864, Mar. 18	A^1 Cancri	231	245	230	31	10 Virginis	264	287	259
18	A^2 Cancri	279	293	277	May 19	c Geminor.	227	236	227
19	ω Leonis	269	286	268	July 8	53 Arietis	63	48	69
June 26	62 Piscium	306	284	302	Oct. 22	27 Piscium	244	221	249
26	62 Piscium	54	31	50	22	29 Piscium	246	223	251
26	δ Piscium	256	233	252	Nov. 19	10 Ceti	312	289	317
26	δ Piscium	104	81	100	Dec. 19	π Arietis	283	267	289
Dec. 5	κ Aquarii	232	211	230	1875, May 12	37 Leonis	335	355	331
1865, Mar. 3	68 Tauri	317	308	314	Oct. 16	ζ Arietis	232	217	236
July 3	α Libræ	314	331	318	16	ζ Arietis	101	87	107
3	α Libræ	38	55	43	Nov. 21	β Virginis	274	296	268
Nov. 4	64 Tauri	141	131	138	21	β Virginis	103	126	98
Dec. 30	115 Tauri	314	310	312	1876, Feb. 2	27 Arietis	291	273	296
1866, Sept. 28	75 Tauri	102	93	100	Apr. 7	f Virginis	296	319	290
28	α Tauri	67	58	65	11	b Scorpii	41	53	37
Nov. 16	67 Aquarii	305	284	301	May 5	50 Virginis	297	319	292
20	ξ Arietis	249	230	245	Nov. 29	47 Arietis	292	276	296
27	c Leonis	281	299	285	1877, Jan. 30	45 Leonis	55	76	50
27	c Leonis	67	85	70	30	ρ Leonis	272	293	266
1867, June 14	49 Libræ	236	248	238	30	ρ Leonis	110	131	104
Nov. 8	10 Ceti	270	247	266	Feb. 26	α Leonis	279	299	274
1868, Feb. 28	μ Ceti	342	324	340	Nov. 20	q Tauri	231	218	231
Mar. 1	θ^2 Tauri	276	266	276	20	q Tauri	111	98	111
1	θ^1 Tauri	255	245	255	20	20 Tauri	264	250	264
May 4	l Virginis	268	290	271	20	30 Tauri	79	66	79
27	18 Leonis	283	301	287	20	17 Tauri	41	28	42
1869, Jan. 24	120 Tauri	246	242	249	1878, Mar. 16	A Leonis	340	360	334
24	119 Tauri	221	217	223	June 5	π Cancri	301	317	294
Aug. 2	α Tauri	70	61	73	Sept. 6	51 Sagittarii	288	280	294
Dec. 14	ξ^2 Ceti	310	291	311	Nov. 10	17 Tauri	263	250	262
1870, Feb. 10	m Tauri	324	318	328	10	17 Tauri	82	69	82
May 14	30 Libræ	324	338	320	10	20 Tauri	221	208	220
Aug. 17	μ Ceti	107	90	110	10	η Tauri	316	304	315
19	64 Tauri	123	113	127	1879, Apr. 30	83 B. Leonis	338	357	333
Sept. 16	i Tauri	86	79	91	May 3	q Virginis	222	245	219
Oct. 1	117 B. Sagittarii	307	304	302	July 28	α Scorpii	198	207	201
14	ζ Tauri	263	260	268	28	α Scorpii	150	159	153
14	ζ Tauri	88	84	92	Aug. 25	142 B. Ophiuchi	248	253	252
1871, Mar. 3	η Cancri	295	308	298	Sept. 26	λ Capricor.	262	243	266
3	39 Cancri	274	287	277	Oct. 4	36 Tauri	98	87	96
Oct. 23	69 Aquarii	327	306	327	Nov. 18	σ Capricor.	274	262	280
23	τ Aquarii	274	253	274	22	16 Piscium	233	210	235
Dec. 20	ν Piscium	210	188	213	Dec. 22	101 Piscium	319	297	318
1872, Feb 21	γ Cancri	249	262	250	1880, Jan. 20	ε Arietis	251	235	246
21	γ Cancri	124	137	125	Mar. 13	101 Piscium	298	277	297
May 19	65 Virginis	263	285	260	21	d^2 Cancri	245	258	240
19	66 Virginis	269	291	266	Apr. 16	56 Geminor.	326	334	322
22	ω^2 Scorpii	299	310	293	May 18	p^2 Leonis	277	299	274
22	ω^2 Scorpii	88	99	82	Sept. 13	50 Sagittarii	308	300	313

GREENWICH—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1880, Nov. 17	υ Tauri	293	282	288	1886, May 6	111 Tauri	291	287	292
19	η Geminor.	265	266	260	June 23	24 Piscium	107	84	103
19	μ Geminor.	236	238	231	Aug. 19	ν Piscium	84	63	81
19	μ Geminor.	138	140	134	Sept. 7	190 B. Sagittarii	319	313	316
20	ζ Geminor.	284	290	280	Oct. 22	44 Leonis	29	50	34
20	ζ Geminor.	73	79	69	22	Pi. X 67.	32	53	37
1881, Jan. 5	19 Piscium	331	308	332	Nov. 21	46 Virginis	131	153	134
12	394 B. Tauri	271	269	267	Dec. 3	*h* Aquarii	256	234	251
Mar. 8	14 B. Geminor.	278	278	272	3	84 Aquarii	272	250	268
16	*q* Virginis	234	257	235	18	γ Virginis	132	155	136
16	*q* Virginis	139	162	140	1887, Jan. 5	*f* Tauri	292	278	292
May 4	5 Cancri	270	282	267	5	*f* Tauri	55	41	55
Sept. 3	33 Sagittarii	231	226	235	6	θ^2 Tauri	47	37	47
Oct. 5	κ Piscium	259	236	258	6	θ^1 Tauri	71	61	71
5	9 Piscium	293	270	292	6	α Tauri	239	230	239
9	54 Arietis	31	14	26	12	45 Leonis	129	150	134
Nov. 12	α Cancri	263	278	260	12	ρ Leonis	242	264	247
12	α Cancri	105	120	102	12	ρ Leonis	111	132	116
29	16 Piscium	283	260	282	28	4 Ceti	236	213	233
29	19 Piscium	272	249	270	28	5 Ceti	222	199	218
Dec. 30	45 Arietis	264	247	260	Feb. 6	3 Cancri	248	259	253
1882, Apr. 1	*e* Leonis	357	20	358	Mar. 2	α Tauri	187	178	188
Aug. 2	22 Piscium	111	88	109	2	α Tauri	164	155	165
Sept. 20	μ Sagittarii	290	289	294	13	γ Libræ	105	119	105
Oct. 1	*l* Tauri	142	136	137	Apr. 30	54 Cancri	309	324	313
2	57 Orionis	79	78	75	30	o^1 Cancri	212	227	216
22	κ Aquarii	330	310	330	July 1	Libræ	332	345	332
24	51 Piscium	203	187	199	Aug. 8	21 Ceti	144	122	142
Nov. 26	64 Orionis	104	104	101	31	45 Capricor.	284	265	279
1883, Mar. 12	*o* Arietis	300	283	295	Sept. 28	42 Aquarii	321	301	317
July 17	16 G. Sagittarii	239	240	242	Oct. 12	α Leonis	268	288	272
Aug. 24	148 B. Tauri	97	85	93	12	α Leonis	83	103	88
Sept. 14	c^1 Capricor.	195	176	193	26	70 Aquarii	288	267	284
14	c^2 Capricor.	275	256	274	28	54 B. Ceti	316	293	314
1884, Feb. 6	120 Tauri	89	86	86	Dec. 27	75 Tauri	277	267	279
Mar. 6	λ Geminor.	246	253	245	1888, Oct. 20	μ Ceti	300	282	302
May 30	16 Sextantis	267	287	269	1889, Feb. 9	*i* Tauri	322	314	326
Dec. 30	115 Tauri	256	252	254	12	63 Geminor.	212	219	216
1885, Feb. 20	38 Arietis	202	184	198	Sept. 16	ζ Tauri	307	304	312
23	130 Tauri	256	254	255	Oct. 5	56 Aquarii	230	209	227
Mar. 22	111 Tauri	303	299	302	29	208 B. Sagittarii	265	258	259
22	117 Tauri	348	344	346	Dec. 31	85 Ceti	223	205	227
27	B. A. C. 3529	309	330	313	1890, Jan. 15	*o* Libræ	74	89	70
27	43 Leonis	229	250	233	Feb. 7	ν Virginis	275	298	275
28	75 Leonis	280	303	285	7	ν Virginis	94	117	94
Apr. 20	Pi. VII 39	321	328	322	Apr. 7	32 Libræ	143	157	138
20	λ Geminor.	207	214	208	30	ν Virginis	232	255	232
20	λ Geminor.	161	168	162	30	ν Virginis	145	168	145
July 22	29 Ophiuchi	338	344	338	May 3	95 Virginis	353	13	350
Aug. 20	95 B. Sagittarii	225	223	224	3	κ Virginis	345	5	342
Sept. 1	θ^2 Tauri	84	74	82	June 2	ω Ophiuchi	308	318	303
1	264 B. Tauri	141	131	139	29	56 B. Scorpii	90	102	86
1	85 Tauri	45	35	42	29	β Scorpii	90	102	86
20	18 Aquarii	305	288	302	Sept. 6	394 B. Tauri	112	110	118
21	150 B. Aquarii	245	225	241	20	24 Ophiuchi	237	244	232
Oct. 1	λ Geminor.	284	290	286	27	33 Piscium	293	270	295
Nov. 17	80 B. Piscium	242	219	238	Oct. 27	ξ^1 Ceti	242	222	246
Dec. 28	θ Virginis	112	134	116	1891, Jan. 4	2 Libræ	63	82	58
1886, Jan. 14	85 Ceti	304	286	301	Feb. 17	121 Tauri	230	226	235
16	θ^2 Tauri	67	57	66	Mar. 26	*l* Virginis	121	143	117
16	θ^1 Tauri	88	78	86	28	ν Libræ	130	146	125
16	264 B. Tauri	239	229	238	Apr. 18	42 Leonis	290	312	291
16	α Tauri	232	224	232	20	ν Virginis	111	134	109
16	α Tauri	123	114	121	Aug. 14	26 Ophiuchi	314	320	309
18	26 Geminor.	284	287	285	Oct. 15	30 Piscium	318	295	321
Mar. 9	ξ^1 Ceti	259	240	256	1892, Feb. 1	376 B. Aquarii	235	212	238
9	64 Ceti	74	54	70	7	118 Tauri (S.)	285	281	289
9	ξ^1 Ceti	107	88	105	7	118 Tauri (N.)	285	281	289
Apr. 10	26 Geminor.	241	259	243	Mar. 8	4 Cancri	211	222	213
15	τ Leonis	333	356	338	Apr. 2	139 Tauri	304	303	307

GREENWICH—Continued.

Date.	Star.	m	m_1	m′
		°	°	°
1892, Aug. 11	14 Ceti	31	8	35
Sept. 12	κ Tauri	95	88	99
15	4 Cancri	103	114	105
Oct. 3	τ Aquarii	291	269	294
Nov. 30	122 G. Piscium	329	307	334
30	122 G. Piscium	328	307	334
Dec. 25	351 B. Aquarii	282	259	286
1893, Feb. 26	c Geminor.	319	328	320
Apr. 18	32 Tauri	307	295	312
21	47 Geminor.	300	306	300
22	λ Cancri	289	302	289
May 6	b Sagittarii	47	36	47
July 9	32 Tauri	80	68	85
30	56 Aquarii	77	56	81
Oct. 19	37 Capricor.	268	250	270
19	38 Capricor.	307	289	310
25	40 Arietis	213	196	218
30	4 Cancri	38	49	37
Nov. 22	δ Arietis	330	314	335
1894, Jan. 12	24 Piscium	295	272	300
20	c Geminor.	297	307	296
Feb. 13	36 Tauri	321	309	324
Mar. 16	4 Cancri	257	268	256
23	40 H. Virginis	117	137	113
25	2 Scorpii	88	101	85
25	3 Scorpii	127	139	123
Apr. 9	χ Tauri	257	247	260
10	107 B. Aurigæ	275	272	277
11	49 Aurigæ	253	256	253
16	σ Leonis	153	176	148
May 12	37 Leonis	248	268	244
30	ζ Piscium	48	26	54
Nov. 15	136 Tauri	301	300	302
15	136 Tauri	44	43	45
1895, Feb. 6	49 Aurigæ	208	211	208
Mar. 10	82 Leonis	236	259	231
10	83 Leonis	252	275	247
10	Pi. XI 71	252	276	247
10	τ Leonis	242	265	237
10	83 Leonis	134	157	128
10	Pi. XI 71	133	156	128
10	τ Leonis	142	165	136
May 4	τ Leonis	277	300	272
9	π Scorpii	136	148	134
11	γ^1 Sagittarii	328	328	328
June 26	α Leonis	307	327	302
26	α Leonis	74	94	69
July 16	47 Arietis	58	40	60
Aug. 6	42 Aquarii	54	34	60
7	81 Aquarii	64	42	70
7	82 Aquarii	212	190	217
12	B. D.+18° 325	99	81	102
Sept. 2	ι Aquarii	286	266	291
15	83 Cancri	85	102	80
29	δ Capricor.	250	231	255
29	δ Capricor.	80	61	85
30	58 Aquarii	258	237	263
Nov. 3	19 Tauri	76	63	77
3	20 Tauri	42	29	43
Dec. 10	ψ Virginis	164	187	160
1896, Mar. 1	343 B. Virginis	61	84	58
19	18 Tauri	256	243	256
27	79 Leonis	316	340	312
27	79 Leonis	72	95	67
Apr. 26	83 Virginis	274	295	271
May 21	υ Leonis	282	305	277
June 22	4 Scorpii	216	228	216
24	38 B. Sagittarii	236	236	239
July 20	τ Scorpii	59	68	61
28	21 Piscium	33	10	37
1896, Oct. 27	52 Geminor.	240	246	236
Dec. 17	η Tauri	330	316	329
1897, May 4	332 B. Tauri	132	126	129
June 18	151 B. Capricor.	327	308	332
18	151 B. Capricor.	12	353	17
July 13	χ Sagittarii	234	226	239
13	χ Sagittarii	117	109	121
23	17 Tauri	250	238	249
23	16 Tauri	190	177	188
23	16 Tauri	163	150	161
23	23 Tauri	314	301	313
23	17 Tauri	101	88	100
23	Pi. III 135	154	142	153
23	η Tauri	292	279	291
23	23 Tauri	36	23	35
23	24 Tauri	62	49	60
23	η Tauri	57	44	55
23	28 Tauri	320	306	318
23	Pi. III 151	98	85	97
23	28 Tauri	28	15	27
23	105 B. Tauri	94	81	92
23	Pi. III 164	316	303	314
Aug. 4	89 Virginis	307	328	306
Oct. 3	48 Sagittarii	285	277	290
3	χ Sagittarii	307	299	312
3	χ Sagittarii	32	24	37
1898, Jan. 3	17 Tauri	240	227	238
3	23 Tauri	302	289	299
3	17 Tauri	112	99	110
3	24 Tauri	277	264	274
3	η Tauri	281	268	279
3	Pi. III 151	239	226	237
3	23 Tauri	53	40	51
3	105 B. Tauri	238	225	236
3	28 Tauri	294	282	292
3	27 Tauri	317	304	315
3	η Tauri	79	66	76
3	27 Tauri	49	36	46
Mar. 13	α Scorpii	260	270	264
13	α Scorpii	104	114	108
Apr. 29	ξ Leonis	204	222	200
May 2	13 B. Virginis	326	349	324
June 5	λ Sagittarii	96	94	101
Sept. 28	16 Piscium	252	229	254
Nov. 22	19 Piscium	228	205	230
Dec. 23	47 Arietis	303	286	300
23	47 Arietis	56	40	53
1899, Jan. 19	μ Arietis	242	224	239
Feb. 22	90 B. Cancri	300	314	296
Apr. 17	3 Cancri	351	2	346
May 26	9 Sagittarii	98	98	103
July 19	88 B. Ophiuchi	67	73	71
19	26 Ophiuchi	89	95	93
Dec. 16	175 H^1. Tauri	248	246	244
16	175 H^1. Tauri	129	127	124
1900, Jan. 9	27 Arietis	336	318	331
Feb. 6	δ Arietis	322	307	317
7	39 Tauri	230	219	225
Apr. 4	ο Tauri	256	251	250
May 7	19 Sextantis	287	308	286
June 2	κ Cancri	285	301	282
July 11	ξ Sagittarii	296	291	300
Sept. 4	36 Sagittarii	247	243	251
4	36 Sagittarii	95	91	100
12	π Arietis	277	260	272
13	13 Tauri	253	240	248
13	14 Tauri	277	263	272
Oct. 3	27 G. Capricor.	257	244	260
1901, Mar. 26	68 Orionis	243	244	239
Apr. 22	B. D.+19° 1110	247	245	242

GREENWICH—Continued.

Date.	Star.	m	m_1	m'
		°	°	°
1901, Apr. 22	57 Orionis.	253	251	248
28	p^3 Leonis	255	277	257
May 31	11 H. Libræ	211	224	216
June 4	171 B. Sagittarii	137	131	140
29	74 B. Ophiuchi	269	276	274
July 28	21 Sagittarii	242	241	246
Aug. 24	24 B. Sagittarii	224	225	228
Oct. 23	κ Aquarii	263	241	261
27	29 Arietis	229	211	224
27	29 Arietis	133	115	128
Dec. 18	λ Piscium	215	191	211
18	λ Piscium	141	117	137
1902, Feb. 12	ε Piscium	326	303	321
12	ε Piscium	33	20	28
13	26 B. Arietis	263	243	258
15	163 B. Tauri	215	204	210
16	ι Tauri	316	308	312
Mar. 17	26 Geminor.	313	316	310
20	ω Leo. (1st)	268	285	269
20	ω Leo. (2d)	268	285	269
May 12	12 Cancri	349	1	349
June 18	P. XVI 3	285	296	290
18	ν Scorpii	287	298	292
Oct. 16	ζ Piscium	302	280	297
Dec. 4	β Capricor.	231	218	230
1903, May 2	68 Geminor.	258	266	258
June 2	4 Leonis	298	317	299
Sept. 3	27 G. Capricor.	274	261	271
Oct. 30	ρ Aquarii	204	183	199
30	ρ Aquarii	152	130	147
Nov. 4	ξ Arietis	315	296	311
9	λ Geminor.	114	121	115
Dec. 2	W. B. II 1033	331	315	327
4	318 B. Tauri	298	291	296
4	318 B. Tauri	56	49	54
10	d Leonis	325	348	331
10	d Leonis	27	50	32
31	75 Tauri	322	312	320
31	75 Tauri	33	24	31
1904, Mar. 22	θ^1 Tauri	321	311	319
22	75 Tauri	221	211	219
Apr. 24	10 Sextantis	279	298	283
July 9	θ^1 Tauri	87	77	86
9	θ^2 Tauri	66	56	65
9	264 B. Tauri	239	229	238
9	α Tauri	229	220	228
9	α Tauri	123	114	122
Aug. 30	ξ^1 Ceti	92	73	88
Sept. 29	γ Tauri	124	114	123
29	71 Tauri	24	14	23
29	θ^1 Tauri	270	260	269
29	θ^2 Tauri	292	282	291
29	θ^2 Tauri	61	51	60
29	θ^1 Tauri	83	73	82
29	264 B. Tauri	244	234	243
Nov. 20	64 Ceti	296	277	293
20	ξ^1 Ceti	273	254	270
Dec. 20	γ Tauri	280	270	279
20	γ Tauri	69	59	68
20	70 Tauri	293	283	292
20	75 Tauri	232	222	231
20	B. D.+15° 633	283	273	282
20	θ^1 Tauri	334	324	333
20	θ^1 Tauri	25	15	24
20	264 B. Tauri	288	279	287
1904, Dec. 20	α Tauri	246	237	245
1905, Jan. 10	φ Aquarii	248	225	242
10	φ Aquarii	108	85	103
17	318 B. Tauri	224	218	224
18	130 Tauri	284	282	286
19	26 Geminor.	316	319	318
Mar. 12	48 Tauri	278	268	278
16	2 B. Cancri	254	257	250
19	56 Leonis	288	310	293
Apr. 12	162 B. Geminor.	355	3	358
12	162 B. Geminor.	5	14	9
15	44 Leonis	260	280	265
15	44 Leonis	102	123	107
17	η Virginis	306	329	311
May 15	38 Virginis	347	10	351
15	38 Virginis	17	40	21
15	k Virginis	234	257	238
Sept. 19	θ^1 Tauri	78	69	79
Oct. 4	B. F. 2471	251	250	248
Nov. 7	27 Piscium	239	215	234
7	27 Piscium	116	92	111
7	29 Piscium	196	172	191
7	29 Piscium	159	135	154
Dec. 9	f Tauri	295	281	295
1906, Jan. 4	ξ^2 Ceti	303	284	301
10	q Geminor.	198	208	203
Feb. 3	α Tauri	228	219	230
3	α Tauri	117	108	118
4	115 Tauri	288	284	290
4	115 Tauri	55	51	58
7	ζ Cancri	252	240	256
Mar. 2	θ^2 Tauri	333	324	335
29	179 B. Tauri	306	295	307
Apr. 3	d^2 Cancri	289	302	294
4	π Cancri	281	298	287
5	α Leonis	127	147	132
6	χ Leonis	307	329	311
27	119 Tauri	266	263	269
27	120 Tauri	282	279	285
Sept. 9	α Tauri	338	329	340
9	α Tauri	3	355	6
Nov. 5	ν Geminor.	95	97	99
19	ο Sagittarii	283	277	278
Dec. 5	X Cancri	37	52	42
1907, Jan. 26	ν Geminor.	290	292	295
Feb. 23	ζ Geminor.	243	249	248
Mar. 20	m Tauri	309	303	313
21	χ^1 Orionis	244	242	248
21	57 Orionis	278	278	282
28	b Virginis	315	338	318
Apr. 19	56 Geminor.	323	330	328
May 24	n Virginis	338	359	338
June 24	ξ Ophiuchi	261	265	257
Sept. 24	μ Ceti	303	286	305
24	μ Ceti	36	19	38
26	64 Tauri	234	224	237
Oct. 2	8 Leonis	98	117	103
24	ι Tauri	71	63	75
Dec. 11	290 B. Aquarii	279	256	276
17	∂ Tauri	337	327	341
17	68 Tauri	265	256	270
1908, Mar. 13	39 Cancri	280	295	285
13	40 Cancri	288	302	293
23	116 B. Ophiuchi	133	139	128

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Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1882, Nov. 26	64 Orionis	255	255	251	1892, July 19	72 Tauri	227	217	232
26	64 Orionis	109	109	105	19	υ Tauri	93	83	98
1883, Jan. 4	κ Libræ	223	236	228	19	72 Tauri	116	106	121
11	117 G. Capricor.	307	288	306	Oct. 3	τ Aquarii	294	272	297
11	c^1 Capricor.	324	305	323	1893, July 6	e Piscium	131	110	136
13	15 Piscium	258	235	255	1894, Jan. 12	24 Piscium	300	277	305
1885, Nov. 22	α Tauri	264	255	263	Apr. 9	χ Tauri	242	232	245
1886, Jan. 16	α Tauri	232	223	231	9	χ Tauri (comp.)	242	232	245
16	α Tauri	126	117	125	11	49 Aurigæ	234	237	234
1891, Mar. 26	l Virginis	245	266	241	1895, June 26	α Leonis	297	317	292
Apr. 25	κ Libræ	87	100	82	26	α Leonis	81	101	76
Nov. 10	τ Aquarii	193	171	194	July 17	η Tauri	88	75	90
1892, Jan. 19	γ Virginis	305	328	301	Sept. 29	δ Capricor.	260	241	265
Mar. 16	λ Virginis	128	147	123	29	δ Capricor.	70	51	75
June 6	λ Virginis	225	244	220	1896, Apr. 19	A Geminor.	239	247	235
8	δ Scorpii	213	225	208					

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1808, Apr. 5	60 Cancri	250	265	248	1811, July 15	α Tauri	313	304	312
May 3	ω Leonis	205	222	205	26	θ Virginis	273	295	278
1809, Apr. 29	8 Libræ	247	264	252	Oct. 23	45 Sagittarii	305	298	303
29	α Libræ	252	269	258	1812, May 24	ν Libræ	243	257	244
29	α Libræ	114	131	119	Aug. 28	α Tauri	230	221	231
June 23	8 Libræ	272	289	277	28	α Tauri	110	101	111
23	α Libræ	277	294	282	Oct. 19	ν Piscium	253	232	251
28	β Capricor.	264	252	264	Nov. 24	α Leonis	188	207	193
28	β Capricor.	75	63	75	24	α Leonis	152	171	157
Nov. 12	β Capricor.	269	257	268	Dec. 10	85 Aquarii	248	226	243
12	β Capricor.	73	61	72	10	87 Aquarii	235	213	230
1810, Feb. 18	π Leonis	259	278	263					

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1905, Aug. 17	27 Piscium	271	248	267	1906, Apr. 5	α Leonis	130	150	135
23	89 Tauri	75	67	76	6	χ Leonis	302	324	306
23	σ^2 Tauri	25	16	26	11	49 Libræ	57	69	56
Sept. 17	μ Ceti	250	232	249	June 7	μ Sagittarii	289	288	286
17	μ Ceti	100	82	98	7	μ Sagittarii	83	82	80
18	f Tauri	83	69	82	July 2	γ Libræ	226	240	226
19	γ Tauri	215	205	215	1907, Jan. 26	ν Geminor.	302	305	307
19	γ Tauri	133	123	134	Mar. 21	χ^1 Orionis	243	242	247
1906, Jan. 4	ξ^2 Ceti	320	301	319	June 21	652 B. Virginis	213	233	213
Apr. 4	π Cancri	278	295	283					

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1890, Nov. 21	33 Piscium	227	203	229	1897, Dec. 6	ε Arietis	266	250	265
Dec. 20	ν Piscium	293	272	293	7	27 Tauri	214	201	211
1891, Apr. 15	κ Geminor.	274	284	278	1898, Jan. 2	ε Arietis	341	325	339
15	κ Geminor.	92	102	95	Mar. 1	125 Tauri	197	194	194
June 12	i Leonis	220	241	220	26	9 Tauri	284	270	281
Nov. 10	69 Aquarii	282	260	283	Apr. 1	54 Cancri	312	327	307
10	τ Aquarii	244	222	245	4	p^5 Leonis	252	275	249
1894, Mar. 16	c Geminor.	341	351	340	July 30	λ Sagittarii	271	269	276
May 14	β Virginis	230	253	225	Nov. 22	19 Piscium	266	243	267
Dec. 8	π Piscium	269	248	273	22	19 Piscium	86	63	87
1895, Feb. 8	γ Cancri	295	309	291	Dec. 19	κ Piscium	266	243	268
1896, Apr. 22	ν Leonis	243	262	238	23	47 Arietis	287	271	284
Oct. 16	e Aquarii	263	243	268	1899, Feb. 18	103 Tauri	221	215	216
1897, Apr. 12	19 Leonis	232	251	227	19	1 Geminor.	307	307	302
Dec. 2	22 Piscium	321	298	324	Mar. 20	56 Geminor.	249	257	244

KASAN—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1899, Apr. 19	h Leonis	265	283	261	1905, Jan. 18	130 Tauri	298	297	300
July 20	7 Sagittarii	242	242	247	Feb. 13	70 Tauri	227	217	226
Oct. 12	57 Sagittarii	278	268	281	13	71 Tauri	311	302	311
1904, Jan. 4	29 Cancri	242	255	245	Mar. 10	389 B. Ceti	252	234	250
4	29 Cancri	108	121	111	Apr. 12	162 B. Geminor.	286	295	290
Feb. 24	θ^1 Tauri	21	11	18	May 13	56 Leonis	337	359	342
29	o Leonis	262	280	266	13	c Leonis	244	267	249
29	o Leonis	101	119	105	14	β Virginis	322	345	326
Mar. 22	γ Tauri	334	324	332	1906, May 1	o^2 Cancri	340	355	345
22	γ Tauri	36	26	34	June 8	π Sagittarii	95	89	91
27	209 B. Cancri	339	355	342	July 5	115 B. Sagittarii	329	326	325
Apr. 24	83 B. Leonis	238	257	241	5	121 B. Sagittarii	246	243	242
May 21	o Leonis	292	310	295	Oct. 25	114 B. Capricor.	234	217	230
Nov. 23	α Tauri	144	134	142	25	ι Capricor.	246	229	241
Dec. 20	θ^1 Tauri	303	293	302	Dec. 25	ξ^2 Ceti	230	211	230
20	θ^2 Tauri	332	322	331	1907, July 23	ν^1 Sagittarii	278	273	273
20	48 Tauri	309	298	308	23	ν^2 Sagittarii	265	260	260
20	γ Tauri	310	300	310	Aug. 18	ξ Ophiuchi	249	253	245

KIEL.

1876, Oct. 6	17 Tauri	239	226	242	1876, Oct. 6	20 Tauri	149	136	151
6	17 Tauri	101	88	104	6	24 Tauri	285	272	288
6	16 Tauri	178	165	181	6	24 Tauri	56	43	58
6	16 Tauri	162	149	165	6	η Tauri	291	278	293
6	23 Tauri	303	290	305	6	η Tauri	50	37	53

KÖNIGSBERG.

1905, Sept. 9	B. D. −18° 5646	258	245	253	1906, Apr. 2	B. D.+18° 1652	280	288	285
18	f Tauri	268	254	268	2	B. D.+18° 1653	308	316	312
18	B. D.+12°485	33	19	33	4	π Cancri	262	280	267
18	f Tauri	37	23	37	5	α Leonis	203	224	208
Oct. 4	B. D. −19° 4858	258	258	256	5	α Leonis	158	179	163
4	B. D. −20° 5003	308	308	305	6	χ Leonis	284	306	288
4	B. D. −19° 4863	260	260	257	6	B. D.+ 7° 2412	300	323	305
4	B. D. −20° 5011	295	295	293	July 2	8 Libræ	206	221	206
4	39 G. Sagittarii	255	255	253	Sept. 9	75 Tauri	242	232	244
1906, Jan. 1	B. D. − 3° 14	288	264	284	Oct. 11	θ Cancri	211	225	216
Feb. 8	π Cancri	215	232	220	11	θ Cancri	132	146	138
Mar. 29	α Tauri	116	108	118	26	B. D. −14° 6228	328	307	323
Apr. 2	B. D.+18° 1616	339	347	343	26	39 Aquarii	322	302	318
2	Berlin A. 2834	337	345	341	26	B. D. −14°6223	261	240	256
2	B. D.+18° 1618	339	347	343	1907, Jan. 20	B. D.+ 3° 219	279	257	278
2	B. D.+18° 1640	270	278	275	Feb. 25	δ Cancri	235	250	240
2	B. D.+18° 1641	272	280	277					

KREMSMUNSTER.

1869, May 18	α Leonis	333	353	337	1869, May 18	α Leonis	28	48	32

LEIDEN.

1857, Sept. 29	128 B. Capricor.	217	199	221	1859, May 7	82 Geminor.	283	265	279
Dec. 26	B.D.+18° 325	213	194	216	Nov. 11	χ Tauri	299	289	298
1858, May 20	56 Leonis	326	349	321	1860, Jan. 6	112 B. Aurigæ	258	254	254
Sept. 21	82 Aquarii	218	195	223	Mar. 1	112 B. Aurigæ	249	246	246
Oct. 21	210 B. Piscium	292	269	296	1	112 B. Aurigæ	116	113	113
Dec. 22	40 Cancri	30	45	26	4	δ Cancri	242	257	237
22	39 Cancri	42	56	37	4	δ Cancri	133	148	128
1859, Apr. 11	176 B. Cancri	269	284	264	June 1	50 G. Libræ	312	328	313
May 5	112 B. Aurigæ	325	322	322	Nov. 5	o^1 Cancri	301	316	296
5	112 B. Aurigæ	54	51	52	5	o^1 Cancri	69	84	64

LEIDEN—Continued.

Date.	Star.	m	m_1	m′
		°	°	°
1860, Nov. 5	o^2 Cancri	239	254	234
5	o^2 Cancri	128	144	123
Dec. 19	16 Piscium	229	206	231
1861, Apr. 19	o Leonis	251	270	247
27	151 G. Ophiuchi	102	106	107
May 19	13 B. Virginis	273	297	272
June 11	ζ Cancri	271	283	266
11	ζ Cancri	106	118	101
Sept. 26	9 Geminor.	140	141	135
26	11 Geminor.	78	79	73
Oct 15	22 B. Piscium	297	274	299
15	9 Piscium	254	231	255
15	9 Piscium	87	64	88
15	κ Piscium	213	190	214
15	κ Piscium	127	104	129
19	B. D.+18° 325	52	33	49
20	ζ Arietis	70	54	66
Dec. 23	e Leonis	273	296	272
1862, Mar. 15	e Leonis	276	299	275
15	e Leonis	102	125	101
Apr. 15	43 B. Libræ	273	290	277
1863, Jan. 9	55 Leonis	92	114	91
27	δ Arietis	104	88	100
Mar. 2	α Cancri	293	309	291
2	α Cancri	87	103	84
24	51 Tauri	199	188	194
24	53 Tauri	48	37	42
Apr. 2	13 B. Virginis	326	349	327
Aug. 7	ω Tauri	293	282	288
Oct. 23	16 Piscium	216	193	214
30	χ^1 Orionis	79	78	75
Nov. 19	κ Piscium	255	232	253
19	9 Piscium	289	266	287
30	60 Cancri	259	274	258
30	60 Cancri	100	116	99
Dec. 24	χ^2 Orionis	89	88	84
27	A^1 Cancri	263	278	262
27	A^1 Cancri	108	123	106
27	A^2 Cancri	306	321	305
27	A^2 Cancri	72	87	71
30	p^3 Leonis	90	112	91
1864, Jan. 24	κ Cancri	310	326	309
24	κ Cancri	46	63	46
Mar. 18	A^2 Cancri	272	287	271
18	A^2 Cancri	105	120	104
19	ω Leonis	266	283	265
19	ω Leonis	102	120	102
Apr. 20	49 Virginis	241	264	245
20	49 Virginis	125	148	129
23	λ Libræ	250	263	255
Nov. 10	62 Piscium	258	235	253
10	62 Piscium	108	85	103
19	κ Cancri	228	244	228
19	κ Cancri	128	144	128
1865, Jan. 8	302 B. Tauri	315	307	311
8	i Tauri	330	323	326
Feb. 9	κ Cancri	275	291	276
Apr. 30	67 Geminor.	260	269	260
July 3	8 Libræ	301	319	306
3	α Libræ	311	329	316
8	ρ^1 Sagittarii	221	214	222
1865, Aug. 6	8 Aquarii	304	289	303
Oct. 4	147 B. Piscium	264	242	260
Nov. 5	115 Tauri	292	288	289
5	115 Tauri	64	60	62
1866, Sept. 28	99 Tauri	304	304	301
28	α Tauri	292	284	290
29	111 Tauri	240	236	239
29	111 Tauri	114	109	112
29	117 Tauri	294	290	293
29	117 Tauri	59	55	58
1867, Oct. 16	85 Tauri	75	65	74
1868, Feb. 8	A Leonis	50	70	55
11	k Virginis	321	343	325
11	k Virginis	46	68	49
28	μ Ceti	335	317	332
28	μ Ceti	35	17	33
Mar. 1	71 Tauri	306	296	306
1	70 Tauri	130	120	130
1	θ^2 Tauri	275	265	274
1	θ^1 Tauri	254	244	254
1	θ^1 Tauri	105	95	105
1	θ^2 Tauri	85	75	85
1	264 B. Tauri	213	203	212
1	85 Tauri	306	296	306
28	γ Tauri	259	248	259
May 4	l Virginis	262	284	265
27	18 Leonis	279	298	284
Sept. 4	33 Ceti	282	260	279
6	μ Ceti	227	209	225
8	71 Tauri	278	268	279
8	71 Tauri	71	61	71
8	θ^2 Tauri	256	246	257
8	264 B. Tauri	208	198	208
8	264 B. Tauri	139	129	139
8	85 Tauri	36	26	36
8	α Tauri	215	205	215
8	α Tauri	138	128	138
9	115 Tauri	122	118	124
1869, Jan. 23	θ^2 Tauri	311	301	313
23	θ^2 Tauri	35	25	36
23	θ^1 Tauri	60	50	61
23	264 B. Tauri	267	257	268
24	120 Tauri	246	242	249
24	119 Tauri	221	217	224
24	119 Tauri	129	125	131
1870, Feb. 9	63 Tauri	262	252	265
10	m Tauri	320	314	324
11	χ^2 Orionis	337	337	342
11	χ^2 Orionis	21	21	25
July 10	158 G. Ophiuchi	258	261	253
Aug. 17	μ Ceti	244	226	246
1871, Jan. 11	ν Virginis	262	285	263
11	ν Virginis	94	117	96
Oct. 23	69 Aquarii	342	320	340
23	69 Aquarii	10	348	8
23	τ Aquarii	280	258	279
23	τ Aquarii	66	44	65
1872, May 19	65 Virginis	255	277	252
19	66 Virginis	263	285	260
22	ω^1 Scorpii	265	277	260
22	ω^2 Scorpii	291	303	287

LEIPZIG.

Date	Star.	m	m₁	m′	Date.	Star.	m	m₁	m′
		°	°	°			°	°	°
1869, May 18	α Leonis	326	346	331	1876, Oct. 6	23 Tauri	312	299	314
1870, June 16	η Capricor.	303	287	298	6	20 Tauri	204	191	206
1871, Nov. 18	ι Capricor.	233	215	231	6	η Tauri	299	286	301
1872, Aug. 15	σ Sagittarii	243	238	238	6	Anon. 24	259	246	261
15	σ Sagittarii	124	119	120	6	Anon. 29	268	255	270
1875, Jan. 30	31 B. Scorpii	308	321	304	6	Anon. 32	277	264	279
Feb. 13	36 Tauri	233	221	237	6	16 Tauri	141	128	143
13	36 Tauri	137	125	140	6	17 Tauri	94	81	96
Mar. 16	ω Cancri	270	281	269	6	23 Tauri	29	16	31
16	4 Cancri	323	334	322	6	20 Tauri	134	121	136
Nov. 16	47 Geminor.	302	308	302	6	η Tauri	41	28	43
1876, Feb. 2	27 Arietis	304	285	308	6	Anon. 24	79	66	81
Apr. 1	47 Geminor.	326	332	324	Nov. 30	η Tauri	231	218	233
June 29	i Virginis	261	283	257	30	27 Tauri	270	257	272
Oct. 6	17 Tauri	245	232	247	30	28 Tauri	253	240	255
6	16 Tauri	197	184	199	30	27 Tauri	75	62	77

NEAR LEIPZIG.

1876, Feb. 2	27 Arietis	304	285	308	1876, Nov. 30	28 Tauri	253	240	255
Mar 6	γ Cancri	316	330	313	1879, Dec. 27	132 Tauri	295	293	290
Oct. 6	16 Tauri	197	184	199	1880, Jan. 28	π Leonis	240	259	236
6	16 Tauri	141	128	143	28	π Leonis	146	165	142
6	17 Tauri	245	232	247	Feb. 18	62 Tauri	307	297	303
6	20 Tauri	204	191	206	Mar. 13	101 Piscium	292	270	291
6	23 Tauri	312	299	314	18	132 Tauri	239	237	234
6	η Tauri	299	286	301	25	13 B. Virginis	300	323	299
6	24 Tauri	293	280	295	July 17	31 B. Scorpii	272	285	276
Nov. 30	η Tauri	231	218	233	Aug. 28	121 Tauri	250	247	245
30	26 Tauri	311	298	313	Sept. 25	1 Geminor.	250	250	245
30	27 Tauri	270	257	272	25	1 Geminor.	107	107	102

MADRID.

1869, Nov. 17	μ Ceti	285	267	286	1869, Nov. 17	μ Ceti	52	34	53

NEUCHATEL.

1872, Aug. 15	σ Sagittarii	248	243	243					

NIKOLAIEFF.

1873, Apr. 30	139 Tauri	243	242	247	1873, Aug. 9	τ Aquarii	269	247	271
May 1	39 Geminor.	248	253	252	9	τ Aquarii	154	132	155
1	40 Geminor.	280	285	284	10	376 B. Aquarii	102	79	106
5	42 Leonis	299	320	298	11	15 Ceti	84	61	88
11	8 Libræ	297	314	291	12	μ Piscium	111	89	115
11	α Libræ	300	317	294	18	39 Geminor.	78	83	81
11	α Libræ	91	108	85	18	40 Geminor.	34	39	37
16	ω Sagittarii	116	106	114	Oct. 3	τ Aquarii	283	261	285
June 5	46 Virginis	231	253	226	9	υ Tauri	10	0	15
July 1	b Virginis	309	332	306	9	72 Tauri	37	27	42
2	γ Virginis	90	113	87	1883, July 15	β Scorpii	293	305	298
19	κ Tauri	118	108	123	15	β Scorpii	54	66	59
19	67 Tauri	96	86	101					

PADUA.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1891, Nov. 10	τ Aquarii	224	202	226	1894, Nov. 20	χ Leonis	161	183	156
10	τ Aquarii	113	91	115	Dec. 10	66 Arietis	289	275	292
1894, Jan. 16	ζ Arietis	230	215	234	11	χ Tauri	314	304	316
16	τ Arietis	301	286	305	11	χ Tauri	26	16	28
July 17	A Sagittarii	247	236	249	1895, Mar. 29	ε Arietis	229	213	232
Aug. 23	27 Tauri	234	221	237	29	ε Arietis	135	119	138
23	28 Tauri	119	106	122	May 1	γ Cancri	270	284	266
23	27 Tauri	101	88	104	1	γ Cancri	118	132	114
Sept. 11	χ Capricor.	191	175	194	July 9	δ Capricor.	255	236	260
11	χ Capricor.	140	124	144	9	δ Capricor.	71	52	76
Oct. 7	A Sagittarii	219	209	221	Sept. 6	62 Piscium	225	202	229
7	A Sagittarii	115	105	117	6	62 Piscium	115	92	120
10	50 Aquarii	251	230	256	Dec. 28	20 Tauri	308	295	309
Nov. 7	70 Aquarii	258	236	263	1896, Jan. 19	14 Piscium	224	201	229

PARIS.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
1810, Jan. 15	δ Tauri	249	239	245	1821, July 23	20 Tauri	93	81	94
15	64 Tauri	274	264	270	Sept. 10	σ Aquarii	296	275	302
May 10	60 Cancri	303	318	306	Oct. 13	16 Tauri	273	261	274
June 15	χ Ophiuchi	237	247	240	13	17 Tauri	306	294	307
July 25	63 Tauri	228	218	225	13	q Tauri	239	227	240
25	63 Tauri	127	117	125	13	20 Tauri	269	257	270
Sept. 18	α Tauri	290	281	287	13	21 Tauri	234	222	235
18	α Tauri	66	57	63	13	17 Tauri	37	25	37
1811, Jan. 19	θ Libræ	39	54	42	13	16 Tauri	76	64	76
Mar. 1	275 B. Tauri	306	297	304	13	q Tauri	103	91	104
1	α Tauri	276	267	274	13	Anon. 4	70	58	71
1	α Tauri	92	84	90	13	20 Tauri	73	61	74
7	o Leonis	317	335	322	13	21 Tauri	108	96	109
Aug. 26	49 Libræ	298	310	300	13	22 Tauri	103	91	104
Sept. 2	λ Aquarii	329	307	324	1822, Feb. 8	υ Leonis	359	22	353
2	λ Aquarii	34	12	29	8	υ Leonis	17	40	13
2	78 Aquarii	284	262	278	Apr. 30	d Leonis	253	275	248
2	78 Aquarii	76	54	71	Dec. 25	η Tauri	291	279	290
Oct. 23	187 B. Sagittarii	262	257	260	1823, June 17	69 Virginis	330	351	329
1812, Jan. 23	α Tauri	197	188	197	1824, Mar. 12	o Leonis	283	301	279
23	α Tauri	153	144	153	Dec. 7	μ Geminor.	109	110	104
Oct. 19	ν Piscium	273	252	270	31	ζ Arietis	311	296	307
21	f Tauri	52	38	51	1825, Feb. 11	θ Ophiuchi	63	67	58
1813, Mar. 6	μ Ceti	258	240	257	Mar. 28	g Geminor.	222	231	217
July 12	π Sagittarii	292	286	287	June 27	19 Scorpii	332	342	337
Dec. 28	ψ^1 Aquarii	242	220	238	July 4	κ Aquarii	309	288	310
1814, Oct. 1	μ Ceti	292	274	294	4	κ Aquarii	33	12	35
1	μ Ceti	49	31	51	Sept. 4	67 Tauri	247	238	242
1817, Dec. 30	γ Virginis	267	290	263	4	67 Tauri	108	99	103
1818, Feb. 13	A Tauri	260	249	265	4	κ Tauri	222	213	217
13	39 Tauri	290	279	295	1826, Sept. 13	c^1 Capricor.	294	276	294
1821, Feb. 6	62 Piscium	277	254	282	Oct. 24	κ Cancri	102	118	101
6	δ Piscium	238	215	243	1827, Jan. 5	π Piscium	294	273	290
12	49 Aurigæ	293	295	291	Feb. 10	60 Cancri	262	277	261
July 23	q Tauri	219	207	220	July 2	49 Virginis	306	328	311
23	20 Tauri	253	241	254	1829, June 13	μ Libræ	307	324	311
23	22 Tauri	221	209	222	13	μ Libræ	50	67	54
23	21 Tauri	210	199	210	Aug. 21	70 Tauri	51	41	49
23	21 Tauri	136	124	137	21	α Tauri	293	284	291
23	16 Tauri	94	82	95	Oct. 15	α Tauri	226	217	225
23	Anon. 4	90	78	90	15	α Tauri	127	118	125

POLA.

Date.	Star.	m	m_1	m'	Date.	Star.	m	m_1	m'
		°	°	°			°	°	°
1886, Apr. 8	α Tauri	244	235	243	1894, Apr. 11	49 Aurigæ	251	254	251
8	α Tauri	124	115	123	1895, June 26	α Leonis	301	321	296
Aug 8	24 Scorpii	262	271	262	Nov. 10	ρ Leonis	276	297	271
1887, Jan. 30	ν Piscium	258	237	255	10	ρ Leonis	110	131	105
Mar. 2	α Tauri	235	226	236	27	δ Piscium	263	240	267
2	α Tauri	120	111	121	1896, July 20	τ Scorpii	303	312	304
8	ρ Leonis	262	283	267	1898, Mar. 13	α Scorpii	256	266	260
July 16	α Tauri	227	218	229	1899, Apr. 28	θ Ophiuchi	264	268	269
1888, Aug. 20	γ Capricor.	296	278	291	28	θ Ophiuchi	92	96	97
Sept. 16	30 Capricor.	277	260	272	1901, Jan. 30	ζ Tauri	196	193	191
Oct. 13	20 Capricor.	245	229	240	30	ζ Tauri	169	166	164
1893, Dec. 13	χ Capricor.	243	224	246	Feb. 21	51 Piscium	300	277	296
1894, Jan. 16	ζ Arietis	232	217	236	July 25	κ Libræ	184	197	189
Mar. 22	α Virginis	281	303	276	Oct. 29	ι Tauri	205	195	200
Apr. 9	χ Tauri	264	254	267					

PRAGUE.

Date.	Star.	m	m_1	m'	Date.	Star.	m	m_1	m'
1883, Oct. 18	68 Tauri	325	315	321	1885, Sept. 1	α Tauri	218	209	216
23	κ Cancri	249	265	250	1	α Tauri	134	125	132
23	κ Cancri	110	126	111	Dec. 2	κ Virginis	193	212	197
Dec. 15	λ Geminor.	64	71	63	2	κ Virginis	173	192	177
1884, Feb. 6	119 Tauri	269	266	266	1886, Feb. 12	γ Tauri	278	268	277
6	119 Tauri	102	99	99	Aug. 8	24 Scorpii	255	263	255
6	120 Tauri	277	274	274	Dec. 3	h Aquarii	271	249	266
6	120 Tauri	96	93	93	1887, Mar. 2	α Tauri	213	204	214
16	λ Virginis	232	251	237	2	α Tauri	143	134	144
16	λ Virginis	132	151	137	8	ρ Leonis	245	266	250
17	ν Libræ	55	71	60	May 4	γ Virginis	213	236	216
Mar. 6	λ Geminor.	236	243	235	1892, Jan. 19	γ Virginis	304	327	301
May 8	λ Virginis	230	249	225	Oct. 3	τ Aquarii	300	278	303
July 3	32 Libræ	201	215	205	1894, Oct. 7	A Sagittarii	217	206	219
Oct. 9	130 Tauri	264	262	262	1895, Sept. 29	δ Capricor.	271	252	276
9	130 Tauri	89	87	87	29	δ Capricor.	57	38	62
Nov. 25	θ Aquarii	261	240	257	1898, Mar. 13	α Scorpii	249	259	253
1885, Jan. 22	e Piscium	293	272	288	13	α Scorpii	110	120	114
Mar. 22	111 Tauri	302	298	300					
Apr. 24	d Leonis	217	239	222					

RADCLIFFE.

Date.	Star.	m	m_1	m'	Date.	Star.	m	m_1	m'
1862, June 9	43 B. Libræ	266	283	270	1869, Aug. 2	α Tauri	71	62	74
1863, Jan. 27	δ Arietis	250	234	245	13	13 Libræ	208	225	207
27	δ Arietis	107	91	102	Nov. 10	30 Capricor.	323	306	318
Mar. 2	α Cancri	301	317	298	Dec. 14	ξ^2 Ceti	91	72	91
Apr. 29	e Leonis	241	264	242	1870, Feb. 11	χ^2 Orionis	351	351	356
29	e Leonis	130	153	131	11	χ^2 Orionis	7	6	11
Oct. 22	κ Aquarii	298	277	298	Aug. 9	4 Capricor.	328	316	324
23	16 Piscium	207	184	205	Oct. 1	117 B. Sagittarii	310	303	305
30	χ^1 Orionis	275	274	271	Nov. 9	68 Tauri	311	301	315
30	χ^1 Orionis	82	81	78	9	68 Tauri	28	17	31
Dec. 19	π Piscium	317	295	312	1871, Oct. 23	69 Aquarii	325	303	324
1864, Mar. 18	A^2 Cancri	279	294	278	23	τ Aquarii	273	251	272
19	ω Leonis	98	115	97	23	τ Aquarii	72	50	91
Apr. 11	57 Orionis	120	119	116	Nov. 15	λ Sagittarii	280	278	274
1866, Jan. 8	h Virginis	352	13	357	18	ε Capricor.	211	193	209
8	h Virginis	9	31	14	27	ι Tauri	275	268	280
Feb. 27	h Leonis	279	297	282	Dec. 1	γ Cancri	260	274	264
1867, Nov. 6	λ Aquarii	269	247	264	1	γ Cancri	109	123	112
8	10 Ceti	269	246	264	20	ν Piscium	208	187	211
1868, Sept. 7	f Tauri	237	219	233	1872, Jan. 23	ω Geminor.	203	208	208
8	θ^2 Tauri	252	242	253	May 22	ω^2 Scorpii	86	98	81
8	θ^1 Tauri	229	220	230	Aug. 12	λ Libræ	259	271	254
9	111 Tauri	334	329	336	Sept. 15	69 Aquarii	283	261	283
1869, Jan. 24	119 Tauri	219	215	222	15	τ Aquarii	248	225	248
24	119 Tauri	129	125	132	15	τ Aquarii	96	73	96

RADCLIFFE—Continued.

Date.	Star.	m	m₁	m′	Date.	Star.	m	m₁	m′
		°	°	°			°	°	°
1872, Oct. 11	35 Capricor.	328	311	327	1874, Apr. 22	ω Cancri	236	247	237
Dec. 9	*f* Piscium	124	101	127	22	4 Cancri	290	302	291
1873, Jan. 22	28 Libræ	241	257	236	Dec. 16	29 Piscium	233	210	238
Apr. 2	118 Tauri (S)	252	248	256	19	π Arietis	282	265	287
2	118 Tauri(N)	252	248	256	1875, Jan. 16	63 Arietis	255	240	259
July 4	λ Virginis	318	337	313	20	*c* Geminor.	304	313	304
Oct. 3	69 Aquarii	283	261	285	May 12	37 Leonis	334	357	331
Dec. 24	τ Aquarii	293	271	295	Oct. 24	σ Leonis	145	168	141
1874, Jan. 25	53 Arietis	234	217	239	Nov. 8	χ Aquarii	319	296	324
26	*A* Tauri	284	273	289	1876, Feb. 2	27 Arietis	289	271	294
27	*k* Tauri	270	264	275	2	27 Arietis	52	33	56
30	*c* Geminor.	218	227	220	Apr. 1	47 Geminor.	348	354	347
Mar. 26	λ Cancri	323	336	324	July 13	ε Piscium	293	270	298

SANTIAGO.

1892, June 14	κ Capricor.	131	112	131	1896, Apr. 1	α Scorpii	241	251	241
July 13	ψ² Aquarii	276	253	279	1	α Scorpii	140	150	141
13	ψ² Aquarii	72	49	75	1	116 B. Scorpii	226	236	227
Aug. 2	ρ Ophiuchi	239	249	234	1	116 B. Scorpii	155	165	156
4	66 B. Sagittarii	291	290	288	17	β Tauri	351	347	349
Sept. 7	10 Ceti	36	13	40	17	β Tauri	16	12	14
Oct. 4	27 Piscium	259	236	263	May 1	201 B. Sagittarii	95	88	98
1894, Feb. 15	κ Aurigæ	239	240	240	26	α Scorpii	290	300	291
16	ι Geminor.	321	329	321	July 19	*A*² Scorpii	239	251	239
16	ι Geminor.	57	65	56	1897, Jan. 11	15 Arietis	264	244	265
16	*b*² Geminor.	230	238	229	18	η Cancri	67	81	62
26	σ Scorpii	337	347	334	May 11	75 Leonis	221	244	217
26	σ Scorpii	53	63	50	July 20	η Piscium	281	259	282
Mar. 17	ξ Cancri	232	248	229	20	η Piscium	56	34	57
17	90 H¹. Cancri	261	277	258	Aug. 1	359 B. Leonis	271	294	267
1896, Jan. 22	ι Arietis	210	189	213	14	16 Piscium	139	116	142
26	116 B. Aurigæ	250	247	248	17	ι Arietis	80	59	80
27	25 Geminor.	304	307	301					

STRASSBURG.

1873, Apr. 2	118 Tauri (S)	252	248	256	1876, July 16	Anon. 10	184	171	187
2	118 Tauri (N)	251	247	256	16	Anon. 24	210	197	213
1874, Aug. 31	29 Arietis	52	33	57	Oct. 5	ε Arietis	242	225	245
Oct. 25	π Arietis	268	251	274	5	ε Arietis	110	93	113
25	π Arietis	76	59	82	6	17 Tauri	243	230	246
1875, Dec. 9	19 Arietis	257	237	261	6	17 Tauri	96	83	99
1876, Jan. 7	Anon. 19	247	234	251	6	23 Tauri	309	296	312
7	Anon. 25	291	278	294	6	23 Tauri	31	18	33
7	Anon. 22	226	213	229	6	20 Tauri	201	188	204
7	Anon. 13	192	179	195	6	20 Tauri	136	123	139
7	26 Tauri	268	255	271	6	24 Tauri	291	278	293
7	Anon. 30	267	254	270	6	24 Tauri	48	35	50
7	27 Tauri	233	220	236	6	η Tauri	297	284	299
7	28 Tauri	214	201	217	6	η Tauri	42	29	45
7	Anon. 40	282	269	285	6	Anon. 1	70	57	73
7	27 Tauri	109	96	112	6	Anon. 15	52	39	55
10	47 Geminor.	285	291	284	6	Anon. 18	54	41	56
Apr. 4	34 Leonis	262	282	257	6	Anon. 24	80	67	82
7	*f* Virginis	288	311	283	6	Anon. 27	71	58	74
June 5	65 B. Scorpii	239	251	238	6	Anon. 29	72	59	74
29	*i* Virginis	266	288	262	6	Anon. 31	67	54	69
July 16	Anon. 1	225	212	228	6	Anon. 32	62	49	64
16	Anon. 1	114	101	117	6	Anon. 37	42	29	44
16	Anon. 7	106	93	109	6	Anon. 39	63	50	65
16	23 Tauri	260	247	263	1877, Mar. 23	κ Geminor.	315	325	312
16	23 Tauri	79	66	81	26	ρ Leonis	134	155	129
16	Anon. 9	204	191	206	Apr. 26	85 Virginis	218	239	215
16	Anon. 8	200	187	203	May 31	17 Capricor.	60	46	65
16	24 Tauri	246	233	249	Aug. 29	μ Arietis	62	44	64
16	η Tauri	251	238	254	30	21 Tauri	36	23	36

STRASSBURG—Continued.

Date.	Star.	m	m_1	m'	Date.	Star.	m	m_1	m'
		°	°	°			°	°	°
1877, Sept. 18	30 Capricor.	221	204	226	1880, Oct. 15	16 Piscium	252	229	253
Nov. 20	q Tauri	94	81	94	1881, Jan 9	ζ Arietis	226	211	222
20	20 Tauri	63	50	63	July 5	83 Virginis	294	315	297
1878, Feb. 15	ζ Cancri	217	230	212	1882, Nov. 2	κ Cancri	246	262	245
15	η Cancri	149	162	144	2	κ Cancri	117	133	116
Mar. 16	A Leonis	334	354	329	1883, Jan. 4	κ Libræ	239	252	244
Apr. 13	48 Leonis	278	299	273	12	κ Aquarii	283	262	281
May 26	51 Piscium	96	73	99	May 17	χ Virginis	262	285	266
June 27	χ Tauri	94	84	92	Sept. 14	c^1 Capricor.	188	169	186
Sept. 6	51 Sagittarii	297	288	302	1884, Mar. 3	δ Tauri	256	246	252
Oct. 5	θ Capricor.	251	235	256	3	64 Tauri	278	268	274
Nov. 10	17 Tauri	279	266	277	July 11	θ Aquarii	290	269	287
10	20 Tauri	241	228	239	11	θ Aquarii	70	49	66
10	17 Tauri	67	54	65	Aug. 15	115 Tauri	90	86	88
10	16 Tauri	106	93	104	1885, Jan. 22	c Piscium	293	271	288
10	20 Tauri	108	95	106	22	c Piscium	66	44	61
1879, Jan. 6	139 Tauri	336	335	332	28	λ Geminor.	259	266	260
Apr. 4	p^3 Leonis	306	328	303	Feb. 23	130 Tauri	258	256	257
July 28	α Scorpii	209	219	213	23	130 Tauri	114	112	113
28	α Scorpii	133	143	137	1886, Apr. 8	α Tauri	232	223	232
Aug. 9	ε Arietis	73	56	71	8	α Tauri	134	125	133
10	27 Tauri	202	189	199	14	48 Leonis	320	341	325
10	Anon. 22	143	130	140	Aug. 8	24 Scorpii	259	267	258
10	Anon. 17	93	80	90	8	24 Scorpii	104	112	104
10	Anon. 19	110	97	107	Nov. 12	γ Tauri	292	282	292
10	27 Tauri	147	134	144	12	γ Tauri	54	44	54
10	26 Tauri	96	83	93	1887, Jan. 6	θ^2 Tauri	322	312	322
10	Anon. 34	50	37	47	6	θ^2 Tauri	28	18	28
10	Anon. 38	78	65	75	6	θ^1 Tauri	56	46	56
10	Anon. 40	88	75	85	Feb. 7	θ Cancri	204	219	209
Oct. 4	36 Tauri	84	72	81	7	θ Cancri	142	157	147
24	θ Aquarii	255	234	259	July 1	η Libræ	331	334	330
24	θ Aquarii	78	57	82	1	η Libræ	37	50	36
30	ε Arietis	125	109	123	6	o Capricor.	67	54	62
1880, Jan. 16	19 Piscium	259	236	261	8	42 Aquarii	40	19	35
28	π Leonis	256	275	252	16	α Tauri	212	203	214
28	π Leonis	131	150	127	16	α Tauri	133	124	135
Feb. 12	9 Piscium	280	257	282	Aug. 12	γ Tauri	287	277	288
Mar. 18	132 Tauri	253	251	248	Oct. 12	α Leonis	277	297	282
21	d^2 Cancri	248	261	243	1898, Mar. 13	α Scorpii	256	266	260
Apr. 11	47 Arietis	255	238	252	13	α Scorpii	105	115	109

TOKIO.

Date.	Star.	m	m_1	m'	Date.	Star.	m	m_1	m'
1905, Jan. 16	264 B. Tauri	269	260	268	1905, Aug. 12	226 B. Sagittarii	255	247	251
16	269 B. Tauri	282	273	282	Sept. 11	σ Aquarii	67	46	62
16	264 B. Tauri	75	65	74	1906, Jan. 6	α Tauri	271	263	273
17	α Tauri	276	267	276	13	α Leonis	254	275	260
17	α Tauri	81	72	81	13	α Leonis	98	118	103
Feb. 20	c Leonis	52	75	57	Mar. 31	71 Orionis	324	323	323
Mar. 18	44 Leonis	308	330	314					

UTRECHT.

Date.	Star.	m	m_1	m'	Date.	Star.	m	m_1	m'
1904, Feb. 24	α Tauri	262	253	260	1905, Feb. 21	η Virginis	42	65	46
Aug. 27	20 Piscium	260	237	255	Mar. 15	110 B. Geminor.	242	247	244
Sept. 2	89 Tauri	275	266	274	20	β Virginis	306	329	311
2	σ^2 Tauri	318	309	317	20	β Virginis	53	76	58
27	85 Ceti	258	240	255	Sept. 17	μ Ceti	243	225	242
27	85 Ceti	96	78	93	17	μ Ceti	108	91	107
Dec. 20	75 Tauri	231	221	230	18	f Tauri	262	247	261
1905, Feb. 13	θ^1 Tauri	249	239	248	18	f Tauri	90	76	89
17	23 H^1. Cancri	285	297	288	Dec. 10	γ Tauri	277	267	278

VIENNA.

Date.	Star.	m	m₁	m′	Date.	Star.	m	m₁	m′
		°	°	°			°	°	°
1869, Jan. 23	θ¹ Tauri	309	299	311	1876, June 30	43 H. Virginis	280	299	276
23	264 B. Tauri	288	278	289	1877, Mar. 26	ρ Leonis	242	262	237
23	α Tauri	287	278	288	Sept. 18	30 Capricor.	235	216	240
Apr. 16	119 Tauri	309	306	313	1878, Jan. 10	51 Piscium	293	270	297
1872, May 17	ν Virginis	254	277	253	Mar. 7	101 Piscium	273	251	275
Aug. 15	σ Sagittarii	246	241	241	16	A Leonis	319	339	314
1873, Apr. 2	118 Tauri	243	239	247	Apr. 9	37 Geminor.	283	288	279
1875, Sept. 12	33 Capricor.	310	293	313	Aug. 6	4 Scorpii	212	224	214
Dec. 7	44 Piscium	237	214	242	Sept. 6	51 Sagittarii	309	300	314
9	19 Arietis	270	250	275	1879, Feb. 26	26 Arietis	277	258	276
1876, Apr. 1	47 Geminor.	332	338	330	Apr. 1	θ Cancri	242	255	237
June 29	ι Virginis	261	283	257					

WASHINGTON.

1839, June 23	b Scorpii	278	290	276	1862, Mar. 10	56 Geminor.	217	224	212
July 6	20 Tauri	195	183	197	May 8	55 Leonis	278	300	277
6	17 Tauri	100	88	102	11	75 Virginis	287	309	290
6	η Tauri	292	280	294	Aug. 1	75 Virginis	266	288	269
6	20 Tauri	140	128	142	Oct. 29	13 Capricor.	232	218	236
Sept. 26	20 Tauri	252	240	254	29	τ Capricor.	243	229	247
26	17 Tauri	56	44	57	1863, Feb. 23	δ Arietis	235	219	230
26	16 Tauri	91	79	93	Mar. 22	40 Arietis	254	237	250
26	q Tauri	121	109	122	Apr. 9	36 Sagittarii	118	113	122
26	20 Tauri	86	74	88	21	105 Tauri	265	259	259
Oct. 17	δ Capricor.	202	184	207	25	29 Cancri	236	249	233
Nov. 19	ε Arietis	292	276	294	30	q Virginis	291	314	294
20	17 Tauri	255	243	256	Aug. 24	29 Sagittarii	202	198	206
20	η Tauri	308	296	310	27	c¹ Capricor.	243	224	244
20	η Tauri	30	18	31	30	51 Piscium	289	266	286
Dec. 12	78 Aquarii	250	228	256	30	51 Piscium	63	40	61
1840, Jan. 20	α Leonis	46	65	41	Sept. 24	51 Aquarii	225	204	225
Apr. 19	τ Scorpii	325	333	326	Nov. 3	ω Leonis	288	306	288
19	τ Scorpii	34	42	35	19	9 Piscium	246	223	244
May 6	μ Cancri	310	320	306	19	κ Piscium	202	179	200
July 10	τ Scorpii	328	336	329	1864, Jan. 23	A¹ Cancri	279	293	277
Sept. 8	ι Capricor.	232	216	237	Feb. 13	53 Arietis	242	226	237
Oct. 13	η Tauri	28	16	27	14	43 Tauri	330	319	325
Nov. 2	ι Capricor.	237	221	242	14	43 Tauri	52	41	47
2	ι Capricor.	87	71	93	16	χ Orionis	281	280	277
3	e Aquarii	262	243	267	16	χ Orionis	101	100	97
1841, June 4	p Sagittarii	71	73	74	25	49 Virginis	172	194	176
Aug. 1	19 Capricor.	282	268	288	May 20	χ Libræ	245	258	249
Sept. 6	17 Tauri	293	281	291	June 20	d Sagittarii	356	349	358
6	16 Tauri	255	243	253	July 23	62 Piscium	30	7	26
6	q Tauri	222	210	220	23	δ Piscium	268	245	264
6	20 Tauri	256	244	254	23	δ Piscium	81	58	77
6	17 Tauri	52	40	50	Aug. 12	ξ Ophiuchi	280	285	284
6	16 Tauri	90	78	88	Nov. 4	ρ Sagittarii	291	284	293
6	q Tauri	122	110	120	5	16 B. Capricor.	307	295	309
6	20 Tauri	88	76	86	5	β Capricor.	314	301	314
6	21 Tauri	128	116	126	1865, Jan. 12	A¹ Cancri	266	280	260
6	22 Tauri	118	106	117	Feb. 2	σ Arietis	292	275	288
25	21 Capricor.	254	239	259	Sept. 11	115 Tauri	31	27	28
Oct. 6	ε Geminor.	51	54	47	29	16 B. Capricor.	285	273	285
Nov. 27	17 Tauri	278	266	276	29	β Capricor.	289	277	288
27	16 Tauri	298	276	296	Oct. 12	60 Cancri	315	330	317
27	20 Tauri	243	231	241	12	60 Cancri	43	58	45
27	q Tauri	336	324	333	12	α Cancri	217	232	218
1842, Jan. 21	16 Tauri	276	264	273	12	α Cancri	144	159	145
21	q Tauri	247	235	244	1866, Jan. 31	π Leonis	249	268	251
21	21 Tauri	240	228	238	Apr. 20	68 Geminor.	263	272	264
21	22 Tauri	248	236	246	June 18	75 Leonis	220	243	225
24	ω Geminor.	252	257	250	July 31	44 Piscium	247	224	242
1862, Feb. 4	101 Piscium	322	300	320	31	44 Piscium	117	94	112

WASHINGTON—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1866, Dec. 24	ξ Leonis	196	214	200	1876, Oct. 27	64 Aquarii	225	204	231
24	ξ Leonis	155	173	159	Nov. 23	42 Aquarii	246	225	250
1867, Apr. 8	318 B. Tauri	264	257	263	24	81 Aquarii	206	184	212
18	96 Virginis	289	309	293	Dec. 26	μ Arietis	251	233	254
18	96 Virginis	82	102	86	27	q Tauri	300	287	302
May 5	α Tauri	286	277	284	1877, Apr. 22	45 Leonis	262	283	257
5	α Tauri	87	78	86	22	45 Leonis	133	154	128
July 9	κ Virginis	285	305	288	July 6	16 Tauri	287	274	288
9	κ Virginis	81	101	85	6	16 Tauri	54	41	55
1868, May 22	α Tauri	297	288	298	6	q Tauri	258	245	259
June 24	49 Leonis	316	337	321	6	q Tauri	82	69	83
July 1	24 Scorpii	233	242	232	6	Anon. 4	294	281	295
Sept. 28	64 Aquarii	207	186	203	6	Anon. 4	46	33	47
1869, Jan. 28	α Leonis	265	285	270	6	20 Tauri	291	278	292
28	α Leonis	104	124	108	6	20 Tauri	49	36	50
Feb. 15	29 Ceti	273	251	270	6	21 Tauri	253	240	254
15	33 Ceti	237	215	235	6	22 Tauri	261	248	262
19	75 Tauri	282	272	283	6	22 Tauri	77	64	[illegible]
1870, Jan. 5	182 B. Aquarii	234	213	230	6	Anon. 12	281	268	282
Feb. 7	μ Ceti	274	256	275	6	Anon. 6	33	20	34
12	ζ Geminor.	337	343	343	6	Anon. 2	74	61	75
Mar. 10	χ^1 Orionis	333	332	337	Sept. 25	μ Arietis	301	283	303
10	χ^1 Orionis	32	31	36	1878, June 14	3 Sagittarii	216	218	219
Sept. 6	η Capricor.	313	297	308	14	3 Sagittarii	154	156	157
1871, Feb. 28	141 Tauri	244	243	248	Sept. 5	σ Sagittarii	235	230	239
June 29	ν Scorpii	305	316	300	17	χ Tauri	82	71	80
Sept. 7	3 Geminor.	70	70	75	Nov. 10	η Tauri	104	91	102
22	χ Sagittarii	234	226	230	13	ε Geminor.	267	270	262
27	33 Piscium	69	46	69	13	ε Geminor.	85	89	81
Oct. 3	ι Tauri	268	262	274	13	ε Geminor.	266	270	263
3	ι Tauri	63	57	69	13	ε Geminor.	85	89	81
21	χ Capricor.	60	245	258	Dec. 2	λ Piscium	76	53	80
27	64 Ceti	211	191	214	7	q Tauri	268	255	266
Dec. 18	24 B. Ceti	284	261	285	7	20 Tauri	299	286	297
1872, Feb. 21	γ Cancri	336	350	339	1879, Feb. 3	ε Geminor.	273	276	268
21	γ Cancri	10	24	14	[illegible]	χ Tauri	309	299	306
Apr. 25	22 Ophiuchi	103	110	98	28	χ Tauri	65	55	62
Sept. 21	ω Tauri	301	290	306	Apr. 25	125 Tauri	261	258	257
21	ω Tauri	27	16	32	26	52 B. Geminor.	249	252	245
21	53 Tauri	232	222	[illegible]	May 28	34 Sextantis	260	282	256
24	37 Geminor.	97	102	[illegible]	June 30	48 B. Scorpii	252	264	256
Oct. 15	33 Ceti	258	236	[illegible]	Aug. 28	o Capricor.	205	192	210
15	f Piscium	282	260	[illegible]	Sept. 6	η Tauri	235	222	232
1873, Feb. 5	67 Tauri	212	202	217	6	27 Tauri	277	264	274
28	14 Ceti	234	211	237	6	28 Tauri	259	246	256
Mar. 1	μ Piscium	245	223	249	6	23 Tauri	248	235	245
5	103 Tauri	274	268	278	6	24 Tauri	117	104	114
Aug. 6	ω Sagittarii	270	260	268	6	η Tauri	112	99	109
6	A Sagittarii	274	264	272	6	26 Tauri	24	11	21
1874, Aug. 20	α Scorpii	295	305	290	6	27 Tauri	77	64	74
Dec. 19	45 Arietis	235	218	240	6	28 Tauri	95	82	92
1875, Aug. 13	234 B. Sagittarii	267	259	267	6	23 Tauri	96	83	93
Sept. 10	A Sagittarii	238	228	240	6	Anon. 7	128	115	125
14	χ Aquarii	236	213	241	Nov. 16	λ Sagittarii	337	334	342
14	χ Aquarii	112	89	117	16	λ Sagittarii	356	353	360
Oct. 3	A Scorpii	267	279	263	Dec. 1	δ Geminor.	248	255	243
3	3 Scorpii	236	248	233	1	δ Geminor.	122	129	117
20	ω Cancri	71	82	69	1880, Apr. 20	36 Sextantis	299	321	296
Nov. 16	c Geminor.	322	331	321	20	36 Sextantis	91	113	88
1876, Jan. 1	70 Aquarii	60	38	64	Sept. 12	117 B. Sagittarii	227	224	232
10	c Geminor.	238	248	236	14	47 B. Capricor.	198	185	203
10	c Geminor.	143	153	142	17	κ Piscium	308	285	310
Feb. 16	A Scorpii	129	142	127	1881, Jan. 7	101 Piscium	265	243	262
16	π Scorpii	301	313	298	Feb. 6	32 Tauri	276	263	271
Mar. 4	49 Aurigæ	331	334	331	May 21	16 Piscium	53	30	52
4	49 Aurigæ	29	32	29	July 18	27 Arietis	137	118	133
5	c Geminor.	324	334	323	Aug. 15	δ Arietis	256	239	251
5	c Geminor.	56	66	54	15	δ Arietis	94	78	90
May 4	f Virginis	249	272	244	1882, Sept. 20	21 Sagittarii	259	257	263
June 1	50 Virginis	259	281	254	1833, Apr. 17	36 Sextantis	256	278	258

WASHINGTON—Continued.

Date.	Star.	m	m_1	m′	Date.	Star.	m	m_1	m′
		°	°	°			°	°	°
1883, June 14	62 Virginis	301	323	306	1907, Mar. 22	ζ Geminor.	295	291	290
July 21	c^2 Capricor.	80	61	78	24	δ Cancri	303	308	298
ept. 6	α Libræ	210	227	215	24	δ Cancri	85	90	80
6	α Libræ	135	152	140	Sept. 14	ξ Ophiuchi	221	234	225
6	8 Libræ	192	209	197	Oct. 24	333 B. Tauri	106	91	102
16	21 Piscium	331	308	328	24	107 Tauri	292	278	288
1884, Mar. 3	68 Tauri	121	111	117	24	107 Tauri	59	44	54
Apr. 4	α Cancri	192	208	194	Nov. 16	117 G. Piscium	203	180	202
6	34 Sextantis	307	329	311	Dec. 11	336 B. Aquarii	335	316	337
6	34 Sextantis	63	85	67	1908, Jan. 18	η Cancri	101	105	96
May 1	A^2 Cancri	283	298	284	18	39 Cancri	109	114	[illegible]
1	A^2 Cancri	91	106	92	18	40 Cancri	103	108	98
June 28	υ Leonis	290	313	295	29	21 G. Sagittarii	108	108	103
28	υ Leonis	73	96	78	Mar. 7	30 B. Tauri	247	233	250
1906, Apr. 6	σ Leonis	334	348	330	10	η Geminor.	204	205	209
6	σ Leonis	52	66	48	10	η Geminor.	141	142	146
May 2	α Leonis	249	259	244	Apr. 6	141 Tauri	214	214	219
3	χ Leonis	297	311	293	9	39 Cancri	323	337	327
8	η Libræ	359	14	0	9	40 Cancri	333	348	338
8	η Libræ	16	31	16	13	Virginis	266	289	267
11	36 Sagittarii	114	118	118	June 11	o Libræ	281	296	278
June 2	65 Virginis	330	348	328	15	49 Sagittarii	119	111	114
25	7 Leonis	267	276	262	16	36 B Capricor.	255	242	251
Sept. 1	ι Aquarii	221	211	226	16	36 B. Capricor.	107	93	102
1	ι Aquarii	128	118	133	July 17	30 Piscium	183	159	182
Oct. 8	64 Orionis	99	91	95	17	30 Piscium	162	139	162
Nov. 21	ι Capricor.	204	197	210	Aug. 3	88 Virginis	259	280	258
22	45 Aquarii	253	241	258	9	49 Sagittarii	238	230	232
1907, Feb. 22	15 Geminor.	230	223	226	10	36B. Capricor.	253	240	249
22	16 Geminor.	303	296	299					

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1898, Nov. 22	19 Piscium	235	212	236	1900, July 11	ξ Sagittarii	300	295	304
1899, Apr. 15	η Gem	0	1	355	1901, Oct. 17	ξ Ophiuchi	328	333	332
17	3 Cancri	331	342	326	1902, Feb. 12	ϵ Piscium	317	294	312
19	h Leonis	302	320	298	14	σ Arietis	313	296	308
1900, Jan. 11	67 Tauri	319	309	314	16	i Tauri	310	303	306
Feb. 6	δ Arietis	312	296	307	Apr. 21	α Virginis	296	318	301
6	δ Arietis	63	47	58	June 18	ν Scorpii	281	292	285
Mar. 5	40 Arietis	314	297	310	July 19	ρ Sagittarii	220	212	221
May 1	ι Tauri	287	281	282	1904, Feb. 24	α Tauri	259	250	257
July 11	33 Sagittarii	311	306	315	24	α Tauri	104	95	102

NOTE.—The values of *m* for the occultations observed at the Cape of Good Hope during the years 1834 to 1895 inclusive are incorrect, *m′* having been substituted for *u* in the formula for ϵ given on page 23. The error of *m* can not exceed 10°. The erroneous values of *m* are published as they were used in the computation of the coefficients of ϵ. the only ones depending on *m*. This error is of the nature of a small accidental error, and its effect on the final result is believed to be neglible.—F. E. R.

CHAPTER VIII.

EQUATIONS OF CONDITION, 1672–1747.

36. Had the present volume been arranged fully on the plan of that of 1878, tabular exhibits of the principal numbers employed in the reductions for parallax would have been given. But this exhibit would serve no purpose except for the revision of the work by correcting the adopted data. Now, such a number of preliminary corrections have been applied one after the other that no additional ones would be useful. The feeling of the writer is that the whole work well deserves being recomputed in great part. The labor of doing this would be much less than has been actually applied in the present work, because it could be done on a uniform system, the tabular places of the moon would be those derived from Hansen's tables after applying all the preliminary corrections necessary. The reductions for parallax should then be made with the definitive values of the lunar parallax. This question involves the decision upon the correct value of the compression of the geoid. The various values of this element have already been discussed. As the final outcome of this discussion the author is less confident than formerly that the value derived directly from geodetic measures of arcs of the parallel and the meridian should be given as little weight as Helmert has given them in deriving his value of the compression. This question belongs to the domain of geodesy, the data of which are continually improving in extent. We should expect that every year will throw more light on the subject. Theory also enters in, especially Clairaut's theorem on the relation between gravity and the compression. This subject would require a much more careful investigation than the author has ever been able to give it, and future geodesists will be in a better condition to reach a conclusion.

Whatever value of the compression be adopted the interesting question will still be whether it can be corrected by the occultations themselves. If so, the methods of correction can be readily derived from the discussions of the lunar parallax, etc., in our chapter on the corrections of Hansen's tables.

The author also deems it quite likely that the method of computing the reductions for parallax may be improved. A careful study of a subject like this often shows that one's predecessors have not adopted the best course at every point.

The probable inequalities of the lunar surface itself form another important set of quantities which have been ignored. These will be mentioned hereafter.

In arranging and solving the equations I have considered separately those made before and after 1750. The present chapter deals mainly with the earlier equations, but the form of the two groups is so nearly the same that we shall give such preliminary equations as are necessary to both series.

37. The coefficients of the equations of condition as found for each individual occultation have been formed by the formulæ and methods given in Chapter II. To facilitate their critical study the following statement of the meaning of the separate data is given:

The date, the place of observation, and the name of the star seem to require no explanation. Commonly the name of the star is that used in the author's Fundamental Catalogue and in the Catalogue of Zodiacal Stars of the American Ephemeris, but no rigorous rule has been followed.

The classification of the phases is twofold—immersion or disappearance indicated by I, and emersion or reappearance by E. When the occultation took place at the bright limb the letter B is added; for the dark limb no indication is given. Hence the absence of the letter B indicates a dark limb observation.

The symbols for the unknown quantities, nine in number, are at the top of each column of coefficients. Their significance is—

λ, the correction of the excess of mean longitude of the moon over that of the star. Assuming the position of the stars to be final, λ would be simply the correction to the moon's mean longitude.

κ, is equivalent to $-2e\delta\pi$, where π is the longitude of the perigee.

$i\theta$, is equivalent to sin $i\,\delta$☊, where ☊ is the longitude of the node.

i, correction to the inclination of the moon's orbit.

b_0, the correction of the moon's tabular latitude, measured perpendicularly to the plane of the orbit, relative to the corresponding latitude of the star. Assuming the center of gravity of the moon to revolve around the earth in a great circle, b_0 is the difference between the centers of mass and of figure of the moon together with any common correction that may be required to the latitude of all the zodiacal stars.

α_0, the correction to the absolute right ascension of the star. In combining the equations this will be the mean correction to all the right ascensions of the stars, or all the positions of the equinox.

δ_0, the correction to the declination of the star, or, in combining the different equations, the mean correction to the declination of all the stars.

ε, the correction to the tabular obliquity of the ecliptic as adopted in the author's Tables of the Sun.

P, the correction to the parallactic equation.

s', the apparent semidiameter of the moon as computed with the constant, $s_0=932''.58$.

D, the tabular apparent distance of the center of the moon from the star.

Assuming the elements and observations to be exact we should have $D=s'$. $s'-D$ is therefore taken as the constant term of the equation of condition.

The manipulation of the equations would have been somewhat facilitated by changing all the signs in the equations from immersion so as to make the coefficients of λ positive throughout, but it was judged preferable to secure that uniformity of system which results from always using the excess of s' over D with its actual sign.

38. Coefficients of Equations of Condition, 1672–1747.

GROUP I—1672-1686.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	$s'-D$ ″	Wt.
1672, Aug. 2	Paris	τ Scorpii	I	−0.89	+0.96	0.00	+0.02	−0.02	−0.01	−0.14	+0.06	+2.3	0.3
1676, Feb. 29	Paris	ε Leonis	E	+0.93	+0.52	+0.07	−0.47	+0.47	−0.07	+0.39	−0.01	+6.0	0.3
Mar. 18	Greenwich	ζ Arietis	I	−0.78	+0.88	−0.37	−0.32	−0.48	−0.06	+0.16	−0.29	−7.4	0.3
23	Greenwich	28 Geminor.	I	−0.69	+0.27	−0.64	+0.26	−0.69	+0.13	−0.17	−0.56	−5.8	0.3
Nov. 9	Greenwich	π Sagittarii	I	−0.97	−0.81	−0.43	+0.21	+0.48	−0.09	+0.15	−0.40	−3.0	0.3
1678, Sept. 24	Greenwich	45 Sagittarii	I	−1.02	−0.72	−0.14	+0.32	+0.35	−0.09	+0.14	−0.28	+4.1	0.3
1680, Sept. 13	Greenwich	α Tauri	IB	−1.07	−0.94	+0.12	−0.25	+0.28	−0.12	+0.12	+0.28	+1.6	0.3
13	Greenwich	α Tauri	E	+1.01	+0.89	+0.17	−0.38	+0.42	+0.20	−0.12	+0.39	−5.0	0.3
Nov. 7	Greenwich	α Tauri	E	+1.10	+0.99	+0.06	−0.13	+0.14	+0.18	−0.14	+0.12	+6.7	0.3
1682, Feb. 15	Paris	θ^1 Tauri	I	−1.08	−0.77	0.00	+0.08	−0.08	−0.17	+0.16	−0.10	+0.7	1.0
15	Paris	θ^2 Tauri	I	−1.04	−0.74	0.00	−0.28	+0.28	−0.08	+0.18	+0.21	+4.9	1.0
Mar. 14	Greenwich	γ Tauri	I	−1.05	−0.66	0.00	+0.19	−0.19	−0.17	+0.19	−0.21	−2.5	1.0
14	Greenwich	γ Tauri	EB	+1.02	+0.64	+0.01	+0.33	−0.33	+0.08	−0.19	−0.26	−0.7	0.3
1683, Feb. 5	Paris	γ Tauri	I	−0.70	−0.13	−0.21	−0.69	+0.72	+0.11	+0.16	+0.59	+2.0	1.0
5	Greenwich	γ Tauri	I	−0.80	−0.15	−0.18	−0.60	+0.62	+0.05	+0.18	+0.51	+1.2	1.0
Apr. 2	Greenwich	119 Tauri	I	−0.96	−0.33	−0.24	−0.31	+0.39	−0.05	+0.11	+0.33	+4.6	1.0
May 4	Greenwich	α Leonis	I	−0.69	−0.61	−0.75	+0.22	+0.78	−0.28	−0.13	+0.41	+2.3	1.0
4	Greenwich	α Leonis	EB	+0.87	+0.76	−0.60	+0.18	+0.62	−0.01	+0.20	+0.40	+2.2	0.3
1684, Dec. 21	Paris	μ Geminor.	IB	−0.30	+0.21	+0.94	+0.11	−0.95	−0.09	+0.02	−0.97	−2.7	1.0
21	Paris	μ Geminor.	E	+0.49	−0.35	+0.84	+0.10	−0.85	−0.06	−0.05	−0.80	−4.5	1.0
21	Paris	μ Geminor.	IB	−0.30	+0.21	+0.94	+0.11	−0.95	−0.08	+0.02	−0.97	−2.5	1.0
21	Paris	μ Geminor.	E	+0.49	−0.35	+0.84	+0.10	−0.85	−0.06	−0.05	−0.80	−4.0	1.0
1685, Oct. 17	Paris	1 Geminor.	IB	−0.89	+0.99	−0.08	+0.01	+0.08	+0.03	+0.10	0.00	+1.7	1.0
1686, June 25	Paris	167 B. Leonis	I	−0.76	+0.55	+0.10	−0.56	−0.57	+0.17	−0.29	−0.36	+2.9	1.0

GROUP II—1699–1720.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ι	$s'-D$	*Wt.*
												″	
1699, Aug. 18	Paris	α Tauri	IB	−0.59	−0.46	−0.29	+0.79	−0.84	−0.19	+0.07	−0.79	−4.5	1.0
18	Paris	α Tauri	E	+0.75	+0.59	−0.24	+0.68	−0.72	0.00	−0.09	−0.65	+2.7	1.0
1701, Sept. 22	Paris	α Tauri	IB	−0.56	+0.25	−0.29	−0.75	+0.81	+0.14	+0.13	+0.71	+1.3	1.0
22	Paris	α Tauri	E	+0.55	−0.24	−0.31	−0.76	+0.82	+0.16	−0.09	+0.78	−0.5	1.0
1705, Aug. 4	Paris	33 Capricor.	IB	−0.70	−0.56	−0.22	+0.74	−0.77	−0.29	+0.13	+0.50	+0.9	1.0
Sept. 2	Paris	τ Aquarii	I	−0.89	−0.78	+0.06	+0.60	−0.60	−0.38	+0.25	+0.19	−2.4	1.0
2	Paris	τ Aquarii	EB	+1.04	+0.92	+0.04	+0.33	−0.33	+0.07	−0.37	+0.21	−3.8	0.3
1706, Jan. 27	Paris	λ Cancri	I	−0.80	+0.27	+0.21	−0.51	−0.55	+0.02	−0.14	−0.53	+1.3	1.0
Apr. 21	Paris	η Leonis	I	−0.76	+0.46	−0.09	−0.58	−0.59	+0.16	−0.31	−0.37	−3.7	1.0
21	Paris	η Leonis	EB	+0.51	−0.31	−0.13	−0.83	−0.84	+0.29	+0.13	−0.48	+0.4	1.0
May 24	Paris	λ Virginis	I	−0.44	+0.47	−0.85	−0.17	−0.87	+0.34	−0.27	+0.46	−0.3	1.0
Nov. 17	Paris	ο Piscium	I	−1.02	−0.90	−0.41	−0.08	+0.42	−0.03	+0.44	+0.12	+0.5	1.0
1707, Apr. 4	Paris	ρ Arietis	I	−0.42	−0.38	+0.37	−0.11	−0.39	+0.25	+0.32	−0.32	+7.9	0.3
Sept. 3	Paris	α Scorpii	I	−0.52	+0.58	−0.56	+0.60	−0.82	+0.14	−0.09	+0.75	−6.2	0.3
3	Paris	α Scorpii	EB	+0.56	−0.63	−0.52	+0.56	−0.77	+0.16	+0.12	+0.73	−0.8	1.0
1709, Apr. 20	Paris	τ Leonis	I	−0.82	−0.65	+0.66	0.00	+0.66	−0.48	−0.28	+0.17	−2.9	1.0
Sept. 23	Paris	20 Tauri	IB	−0.88	+0.02	+0.11	−0.46	−0.47	−0.20	+0.20	−0.37	+3.5	0.5
23	Paris	22 Tauri	E	+0.53	−0.01	+0.19	−0.82	−0.85	−0.13	−0.15	−0.71	−2.8	1.0
1710, Dec. 4	Paris	17 Tauri	I	−0.88	+0.79	+0.04	+0.23	+0.23	+0.04	+0.21	+0.24	+2.0	1.0
1711, Sept. 30	Paris	η Tauri	IB	−0.46	+0.52	+0.36	+0.78	+0.86	+0.16	+0.12	+0.75	−3.0	0.3
30	Paris	η Tauri	E	+0.48	−0.54	+0.34	+0.76	+0.84	+0.13	−0.09	+0.66	−0.7	1.0
1712, May 15	Paris	e Leonis	I	−0.55	−0.08	+0.39	−0.74	+0.84	−0.43	−0.15	+0.20	−5.2	1.0
1713, Dec. 1	Luxemburg	τ Tauri	I	−0.59	+0.10	−0.78	−0.14	−0.80	−0.09	+0.03	−0.70	−0.3	1.0
1714, Mar. 20	Luxemburg	247 B. Tauri	I	−0.65	−0.08	+0.76	+0.11	+0.77	+0.01	+0.06	+0.75	+2.4	1.0
21	Paris	ο Tauri	I	−0.94	+0.11	+0.32	−0.03	+0.32	−0.07	−0.02	+0.40	−2.7	1.0
21	Luxemburg	ο Tauri	I	−0.94	+0.11	+0.32	−0.03	+0.32	−0.07	−0.02	+0.40	−1.5	1.0
Apr. 6	Paris	ξ Sagittarii	E	+1.02	+0.59	+0.28	−0.14	−0.32	+0.11	−0.15	+0.23	+3.1	1.0
6	Luxemburg	ξ Sagittarii	E	+1.03	+0.59	+0.28	−0.16	−0.32	+0.12	−0.15	+0.23	+3.0	1.0
Sept. 27	Luxemburg	ω Tauri	E	+0.98	+0.49	−0.38	−0.01	−0.38	+0.08	−0.09	−0.42	+1.3	1.0
Oct. 2	Luxemburg	α Cancri	E	+0.85	−0.55	−0.16	+0.39	−0.42	+0.11	+0.24	−0.40	−2.2	1.0
1715, July 21	Paris	δ Piscium	IB	−0.87	−0.75	+0.49	+0.36	+0.61	+0.07	+0.30	+0.14	−5.9	0.3
Aug. 15	Paris	κ Aquarii	IB	−0.54	−0.30	−0.29	−0.81	−0.86	−0.35	+0.12	+0.39	−1.0	0.3
15	Paris	κ Aquarii	E	+0.76	+0.43	−0.24	−0.67	−0.71	−0.14	−0.27	+0.27	−5.4	0.3
Oct. 9	Paris	κ Aquarii	I	−0.86	−0.44	−0.23	−0.53	−0.58	−0.29	+0.24	+0.29	+6.5	0.3
Dec. 30	Paris	κ Aquarii	I	−0.95	−0.37	−0.19	−0.38	−0.42	−0.22	+0.26	+0.24	+1.6	1.0
1717, Sept. 25	Paris	α Tauri	IB	−1.07	−0.67	+0.04	−0.07	+0.08	−0.11	+0.12	+0.08	−7.4	0.3
25	Paris	α Tauri	E	+1.05	+0.66	+0.11	−0.20	+0.22	+0.14	−0.11	+0.19	+2.3	1.0
25	Luxemburg	α Tauri	IB	−1.07	−0.67	+0.04	−0.07	+0.08	−0.11	+0.12	+0.08	−3.6	0.3
25	Luxemburg	α Tauri	E	+1.05	+0.66	+0.11	−0.20	+0.22	+0.14	−0.11	+0.19	−0.8	1.0
1718, Feb. 9	Luxemburg	α Tauri	I	−1.04	−0.49	+0.07	−0.18	+0.19	−0.08	+0.12	+0.17	−0.8	1.0
Sept. 9	Luxemburg	337 B. Aquarii	IB	−0.59	+0.65	+0.76	−0.02	+0.76	+0.27	+0.24	−0.19	−1.0	0.5
9	Paris	337 B. Aquarii	IB	−0.58	+0.64	+0.76	−0.02	+0.76	+0.21	+0.24	−0.19	−1.6	0.5
1719, Apr. 22	Paris	α Tauri	I	−0.84	+0.30	+0.02	+0.49	−0.50	−0.09	+0.14	−0.50	+2.0	1.0
22	Paris	α Tauri	EB	+0.76	−0.27	+0.02	+0.62	−0.62	−0.08	−0.12	−0.55	−1.3	1.0
22	Luxemburg	α Tauri	I	−0.84	+0.30	+0.02	+0.49	−0.49	−0.09	+0.14	−0.50	+1.1	1.0
Aug. 21	Luxemburg	γ Libræ	I	−1.06	−0.83	+0.03	−0.26	−0.26	−0.09	−0.22	+0.18	+2.3	1.0
Oct. 30	Paris	α Tauri	E	+0.85	−0.63	+0.09	+0.40	−0.41	−0.08	−0.17	−0.33	−4.6	0.3
Nov. 26	Paris	γ Tauri	IB	−0.78	+0.68	−0.08	−0.51	+0.52	+0.12	+0.19	+0.42	−0.5	0.5
1720, Apr 20	Paris	γ Virginis	I	−0.29	−0.23	−0.60	+0.75	+0.96	−0.36	−0.04	−0.11	+2.5	1.0
20	Paris	γ Virginis	EB	+0.52	+0.41	−0.55	+0.69	+0.88	−0.23	+0.22	−0.08	−3.6	1.0

GROUP III—1725–1729.

1725, Feb. 19	Luxemburg	A Tauri	I	−1.10	−0.99	+0.16	−0.05	−0.17	−0.26	+0.27	−0.22	−2.3	1.0
1727, Feb. 27	St. Petersburg	9 Tauri	I	−1.02	−0.19	+0.01	−0.02	−0.02	−0.14	+0.27	−0.02	+6.5	0.3
Sept. 6	Paris	17 Tauri	E	+0.80	−0.16	−0.25	+0.51	+0.57	+0.21	−0.20	+0.47	+3.6	1.0
6	Paris	q Tauri	E	+0.79	−0.15	+0.26	−0.52	−0.58	−0.07	−0.24	−0.48	−1.1	1.0
6	Paris	20 Tauri	E	+0.98	−0.19	−0.01	+0.02	+0.02	+0.10	−0.27	+0.02	+3.5	1.0
1729, Dec. 3	St. Petersburg	17 Tauri	I	−0.87	+0.91	+0.07	+0.22	+0.23	+0.05	+0.19	+0.26	+1.1	1.0
3	St. Petersburg	16 Tauri	I	−0.77	+0.81	−0.14	−0.47	−0.49	−0.01	+0.18	−0.36	+3.5	1.0
3	St. Petersburg	20 Tauri	I	−0.59	+0.62	−0.23	−0.71	−0.75	−0.13	+0.12	−0.59	+1.1	1.0
3	St. Petersburg	23 Tauri	I	−0.26	+0.27	+0.30	+0.91	+0.96	+0.15	+0.07	+0.83	+1.4	1.0
3	St. Petersburg	η Tauri	I	−0.79	+0.82	+0.15	+0.46	+0.48	+0.09	+0.19	+0.45	+0.5	1.0
3	St. Petersburg	28 Tauri	I	−0.78	+0.82	+0.15	+0.47	+0.50	+0.09	+0.17	+0.48	+1.2	1.0
3	St. Petersburg	27 Tauri	I	−0.53	+0.56	+0.25	+0.77	+0.81	+0.13	+0.11	+0.73	+1.6	1.0

GROUP IV—1736–1739.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	b_0	α_0	δ_0	ε	s′–D	Wt.
												″	
1736, Apr. 14	St. Petersburg	α Tauri	I	−0.81	−0.13	+0.30	−0.54	+0.62	+0.02	+0.10	+0.56	−2.9	1.0
Aug. 1	St. Petersburg	α Tauri	IB	−0.99	+0.04	+0.07	−0.14	+0.16	−0.03	+0.12	+0.15	−3.4	1.0
Oct. 22	St. Petersburg	α Tauri	IB	−0.98	+0.22	−0.01	+0.02	−0.02	−0.03	+0.12	−0.01	−2.9	1.0
1737, May 7	St. Petersburg	ξ Leonis	I	−1.05	−0.61	+0.20	+0.10	−0.22	−0.07	−0.22	−0.16	−0.7	1.0
July 22	St. Petersburg	θ^1 Tauri	EB	+0.42	−0.33	−0.10	+0.88	−0.89	−0.16	−0.09	−0.79	+1.3	1.0
22	St. Petersburg	θ^2 Tauri	EB	+0.80	−0.63	−0.06	+0.49	−0.49	−0.10	−0.15	−0.43	−2.0	1.0
1738, Jan. 2	St. Petersburg	71 Tauri	I	−0.52	+0.54	−0.03	−0.81	+0.81	+0.18	+0.11	+0.70	+1.8	1.0
2	St. Petersburg	θ^1 Tauri	I	−0.90	+0.93	0.00	+0.03	−0.03	+0.04	+0.18	−0.08	0.0	1.0
2	St. Petersburg	θ^2 Tauri	I	−0.85	+0.87	−0.01	−0.35	+0.35	+0.09	+0.18	+0.27	+0.8	1.0
2	St. Petersburg	264 B. Tauri	I	−0.79	+0.82	+0.02	+0.47	−0.47	−0.04	+0.16	−0.48	+2.5	1.0
2	St. Petersburg	α Tauri	I	−0.52	+0.54	+0.06	+0.81	−0.81	−0.10	+0.09	−0.78	−1.1	1.0
2	St. Petersburg	α Tauri	EB,	+0.49	−0.50	+0.06	+0.84	−0.84	−0.15	−0.10	−0.76	−0.5	1.0
2	Paris	α Tauri	I	−0.85	+0.87	+0.02	+0.33	−0.33	−0.01	+0.15	−0.35	+0.7	1.0
2	Paris	α Tauri	EB	+0.87	−0.90	+0.02	+0.24	−0.24	−0.09	−0.15	−0.19	0.0	1.0
Feb. 2	St. Petersburg	f Geminor.	I	−0.48	+0.19	+0.67	+0.56	−0.87	+0.05	−0.04	−0.83	−1.3	1.0
Aug. 8	St. Petersburg	71 Tauri	IB	−0.77	+0.86	−0.11	−0.49	+0.51	+0.14	+0.17	+0.42	−1.0	1.0
8	St. Petersburg	α Tauri	IB	−0.57	+0.64	+0.22	+0.74	−0.77	−0.11	+0.11	−0.75	+0.4	1.0
Oct. 2	St. Petersburg	α Tauri	IB	−0.72	+0.80	+0.20	+0.56	−0.59	−0.07	+0.14	−0.60	+3.6	1.0
2	St. Petersburg	α Tauri	E	+0.80	−0.89	+0.14	+0.41	−0.43	−0.13	−0.17	−0.35	−4.5	1.0
Dec. 23	Paris	α Tauri	I	−0.84	+0.88	−0.14	−0.33	+0.36	+0.10	+0.19	+0.28	+2.8	1.0
23	Paris	α Tauri	EB	+0.74	−0.78	−0.22	−0.53	+0.57	+0.07	−0.15	+0.58	−2.0	1.0
1739, Oct. 23	St. Petersburg	85 Geminor.	IB	−0.87	+0.98	+0.22	+0.01	−0.22	+0.06	−0.06	−0.28	+0.2	1.0
23	St. Petersburg	85 Geminor.	E	+0.89	−1.00	+0.10	0.00	−0.10	−0.03	+0.07	−0.02	−3.9	0.3
24	St. Petersburg	δ Cancri	IB	−0.89	+0.99	+0.05	−0.01	−0.05	+0.06	−0.14	−0.11	+4.4	0.3
24	St. Petersburg	δ Cancri	E	+0.89	−0.99	−0.07	+0.01	+0.07	−0.06	+0.14	+0.13	−6.4	0.3

GROUP V—1746–1747.

1746, Mar. 26	St. Petersburg	17 Tauri	I	−0.92	+0.72	+0.04	−0.08	−0.09	−0.06	+0.25	−0.07	+0.2	1.0
26	St. Petersburg	16 Tauri	I	−0.53	+0.42	+0.37	−0.73	−0.82	−0.22	+0.12	−0.69	+0.9	1.0
26	St. Petersburg	23 Tauri	I	−0.56	+0.44	−0.36	+0.70	+0.79	+0.18	+0.19	+0.67	+2.1	1.0
26	St. Petersburg	24 Tauri	I	−0.87	+0.68	−0.14	+0.28	+0.31	+0.05	+0.26	+0.27	+2.2	1.0
26	St. Petersburg	η Tauri	I	−0.86	+0.67	−0.17	+0.33	+0.37	+0.06	+0.27	+0.32	0.0	1.0
26	St. Petersburg	28 Tauri	I	−0.80	+0.63	−0.22	+0.44	+0.49	+0.09	+0.25	+0.41	+2.0	1.0
26	St. Petersburg	Anon. 8	I	−0.90	+0.70	+0.08	−0.15	−0.17	−0.06	+0.25	−0.13	+1.2	1.0
26	St. Petersburg	Anon. 9	I	−0.91	+0.71	+0.07	−0.13	−0.15	−0.07	+0.26	−0.12	+1.7	1.0
26	St. Petersburg	Anon. 4	I	−0.45	+0.35	+0.39	−0.77	−0.87	−0.23	+0.10	−0.72	+0.6	1.0
26	St. Petersburg	Anon. 10	I	−0.85	+0.66	+0.17	−0.34	−0.38	−0.12	+0.24	−0.30	+0.6	1.0
26	St. Petersburg	Anon. 15	I	−0.89	+0.70	−0.11	+0.22	+0.25	+0.03	+0.27	+0.21	+1.0	1.0
26	St. Petersburg	Anon. 18	I	−0.90	+0.70	−0.12	+0.20	+0.22	+0.02	+0.27	+0.18	−0.6	1.0
26	St. Petersburg	Anon. 29	I	−0.83	+0.65	+0.20	−0.39	−0.44	−0.12	+0.20	−0.37	+2.6	1.0
1747, Jan. 20	St. Petersburg	16 Tauri	I	−0.45	+0.50	−0.20	+0.85	+0.87	+0.19	+0.15	+0.74	−0.5	1.0
20	St. Petersburg	q Tauri	I	−0.86	+0.96	−0.05	+0.25	+0.25	+0.06	+0.23	+0.24	+0.9	1.0
20	St. Petersburg	21 Tauri	I	−0.89	+0.99	0.00	0.00	0.00	0.00	+0.24	+0.02	−2.1	1.0
20	St. Petersburg	20 Tauri	I	−0.63	+0.70	−0.13	+0.70	+0.71	+0.16	+0.19	+0.61	−2.7	1.0
20	St. Petersburg	22 Tauri	I	−0.88	+0.98	−0.02	+0.12	+0.12	+0.03	+0.24	+0.11	+0.2	1.0
July 30	St. Petersburg	Anon. 4	E	+0.79	−0.84	−0.01	+0.48	+0.48	+0.11	−0.19	+0.34	−0.6	1.0
30	St. Petersburg	20 Tauri	E	+0.82	−0.86	−0.01	+0.42	+0.42	+0.09	−0.20	+0.32	+0.1	1.0
30	St. Petersburg	q Tauri	E	+0.89	−0.94	0.00	−0.14	−0.14	−0.03	−0.23	−0.16	+0.4	1.0

Conditional Equations Which Have Not Been Used on Account of Weakness or Discordances.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ
1676, Feb. 29	Paris	*e* Leonis	IB	−0.82	−0.46	+0.11	−0.7	+0.68	−0.44	−0.25	+0.13
June 29	Greenwich	*κ* Aquarii	E	+1.01	+0.02	+0.03	−0.1	−0.09	+0.08	−0.40	+0.32
Aug. 19	Greenwich	*o* Sagittarii	I	−0.93	−0.74	+0.48	−0.2	−0.52	−0.23	+0.14	+0.44
31	Greenwich	Mars	IB	−0.81	+0.88	−0.43	0.0	−0.43	+0.02	+0.01	−0.35
31	Greenwich	Mars	E	+0.89	−0.97	−0.19	0.0	−0.18	−0.01	+0.01	−0.28
1680, Jan. 16	Greenwich	*α* Cancri	IB	−0.95	+0.12	−0.15	−0.3	+0.34	−0.15	−0.20	−0.30
Nov. 7	Greenwich	*α* Tauri	IB	−1.17	−1.00	−0.01	0.0	−0.03	−0.26	+0.14	−0.03
1683, Feb. 5	Greenwich	*γ* Tauri	EB	+0.87	−0.14	−0.13	−0.5	+0.52	+0.18	−0.16	+0.51
Apr. 2	Greenwich	119 Tauri	EB	+0.98	−0.34	−0.15	...	+0.25	....	....	....
1690, July 2	Paris	27 Tauri	I	−1.05	−0.80	+0.15	−0.3	−0.35	−0.29	+0.24	−0.29
1709, Sept. 23	Paris	*q* Tauri	IB	−0.30	+0.01	+0.23	−0.9	−0.95	−0.25	+0.05	−0.80
23	Paris	22 Tauri	IB	−0.36	+0.01	+0.22	−0.9	−0.93	−0.25	+0.06	−0.79
1710, Dec. 4	Paris	22 Tauri	I	−0.40	+0.33	−0.14	−0.9	−0.91	−0.20	+0.07	−0.75
4	Paris	21 Tauri	I	−0.05	+0.04	−0.16	−1.0	−1.00	−0.21	−0.02	−0.85
1711, Sept. 30	Paris	20 Tauri	IB	−0.79	+0.88	−0.21	−0.5	−0.50	−0.08	+0.16	−0.36
30	Paris	*q* Tauri	IB	−0.20	+0.22	−0.42	−0.9	−0.99	−0.18	+0.01	−0.80
1714, Apr. 6	Paris	*ξ* Sagittarii	IB	−0.98	−0.58	+0.26	−0.1	−0.30	−0.15	+0.14	+0.38
6	Luxemburg	*ξ* Sagittarii	IB	−0.98	−0.58	+0.26	−0.1	−0.30	−0.15	+0.14	+0.38
1719, Apr. 22	Luxemburg	*α* Tauri	EB	+0.73	−0.26	+0.03	+0.6	−0.64	−0.08	−0.14	−0.57
Oct. 30	Luxemburg	*α* Tauri	I	−0.75	+0.56	+0.12	+0.6	−0.60	−0.12	+0.13	−0.60
30	Luxemburg	*α* Tauri	E	+0.85	−0.63	+0.08	+0.4	−0.41	−0.05	−0.17	−0.33
1727, Sept. 6	Paris	17 Tauri	IB	−0.93	+0.20	−0.12	+0.2	+0.26	+0.01	+0.26	+0.22
6	Paris	16 Tauri	IB	−0.89	+0.18	+0.18	−0.3	−0.39	−0.15	+0.23	−0.31
6	Paris	*q* Tauri	IB	−0.57	+0.12	+0.36	−0.5	−0.82	−0.23	+0.11	−0.68
6	Paris	20 Tauri	IB	−0.93	+0.18	+0.13	−0.2	−0.29	−0.13	+0.24	−0.24
6	Paris	16 Tauri	E	+0.97	−0.19	+0.03	−0.1	−0.07	+0.05	−0.26	−0.07
1733, Mar. 22	St. Petersburg	*ν* Geminor.	I	−1.00	−0.50	−0.23	+0.1	−0.26	−0.09	−0.10	−0.19
25	St. Petersburg	*κ* Cancri	I	−0.49	+0.06	+0.34	−0.8	+0.88	−0.28	−0.09	+0.66
1738, Aug. 8	St. Petersburg	71 Tauri	E	+0.69	−0.76	−0.15	−0.6	+0.66	+0.11	−0.13	+0.65
8	St. Petersburg	θ^1 Tauri	IB	−0.88	+0.98	+0.06	+0.2	−0.26	−0.03	+0.18	−0.29
8	St. Petersburg	θ^2 Tauri	IB	−0.91	+1.00	−0.03	−0.1	+0.12	+0.03	+0.19	+0.05

Discussion of the Equations of Condition, 1672–1747.

39. The fact that the moon's longitude is subject to fluctuations which can not as yet be expressed by any known formula prevents the general solution of the equations in their entirety. Even were this not the case the fact that seven of the unknown quantities vary with the time would render a single solution laborious. The point first stated renders it necessary to proceed by approximations. The first step is to determine the fluctuations in the mean longitude. This is facilitated by two circumstances. The first is the minuteness of the unknown quantities, which, with the exception of λ, are only small fractions of a second. The other is the smallness in the general mean of any correlation between the mean longitude and any of the other unknown quantities.

All the unknown quantities except λ are constant, or increase uniformly with the time. λ is therefore exceptional in being subject to unknown fluctuations. Our method of proceeding must therefore be by successive approximations. The first approximation will consist in determining λ, assuming that all the other unknown quantities vanish. As the latter are quite small, this proceeding will lead to a fairly precise correction of the mean longitude at various epochs. We shall divide the equations into groups extending through periods of time in which we may suppose the difference between the true values of λ and a value increasing uniformly with the time to be smaller than the probable error of the mean derived from the group. By representing these preliminary corrections to the mean longitude by a smooth curve we shall determine values which can replace λ in the equations. Each term containing λ is then to be carried over to the second member of its equation. We shall then have a system of simultaneous equations in which the unknowns will vary uniformly with the time.

By assigning to each unknown the form $x+yt$, all the equations could be solved by least squares as a single system. But this method would be so laborious that it is desirable to abbreviate it, which we can readily do without appreciably detracting from the weight of the final result. The process will consist in dividing the equations into groups, solving each group as if the unknown were a constant, and then, from the series of values thus obtained, finding the nearest expression increasing uniformly with the time. If we deem it remunerative we can reinsert these values in the normal equations and thus obtain a second approximation to the values of the unknowns. The question whether it is necessary to continue the approximations further can be considered later.

The divisions between the groups used in forming λ is shown by blank spaces, and the approximate mean epoch for each group will otherwise supply a sufficient guide in comparing the results.

The work of deriving the mean corrections λ consists in a solution by least squares of the several groups of equations for that unknown, all the other unknown quantities being supposed to vanish. As their values have been made as small as convenient by preliminary corrections, and as there is only a small systematic correlation between the corrections to the mean longitude and to the other elements, the preliminary values obtained in this way will probably differ from the best obtainable ones by quantities less than the probable amount of the accidental errors.

Thus if the equations be taken as expressed in the form

$$a\lambda = n,$$

the normal equation will be

$$[aa]\lambda = [an],$$

and the solution will be

$$\lambda = \frac{[an]}{[aa]}.$$

Equations in which the square of the coefficient a is less than 0.10 have been generally omitted, as the effect of systematic errors increases as their coefficient diminishes.

Systematic errors of phase.—The most troublesome feature of the equations is the systematic character of the errors to which certain of the observations are liable. Immersions at the dark limb, that is, before full moon, are indeed fairly free from such errors. Fortunately, these comprise nearly a majority of all the observations; but it is, on several accounts, desirable to utilize the entire series. The character of the systematic errors to which observations other than dark limb immersions are liable is readily seen. An observation of emersion is always liable to be recorded too late through the observer failing to catch the star at its first reappearance. We might suppose that a good observer should always know whether he has or has not actually seen the star emerge. But experience shows that, measured in this way, few or perhaps no observers are free from defects. As I have already remarked, experience shows that when an observer estimates an error of his observation, his estimate is commonly but a small fraction of the truth, perhaps between one-tenth and two-tenths.

In a phenomenon at the bright limb an immersion is necessarily recorded when the star disappears, which may be before it reaches the limb, and an emersion when it reappears, which may be after it has left the limb. The result of all three of these classes of systematic error is the same in sign; the actual distance of the star from the moon's center at the assigned moment is greater than the semidiameter. The residual of $s'-D$ will therefore always be negative in sign. We must, therefore, always look with suspicion on abnormal negative values of $s'-D$ in all three cases.

The liability to bright limb error varies of course with the quality of the telescope and the magnitude of the star. In the case of a star of the first magnitude, especially Aldebaran, the true phase should always be observed, yet exceptions appear now and then. The presumption is also in favor of any other first magnitude star being free from the error. We must also expect that, as the telescope has been improved, the number of defective observations of this class should diminish. This is found to be the case.

What was actually done was to make a general study of the residuals $s' - D$ throughout the whole series in order to ascertain the frequency of seemingly abnormal negative values in the cases under consideration, and to form some estimate of the law of their variability with the time and the magnitude of the star. But it was not found practicable to formulate a universal rule applicable to all cases. What I actually did was to reject the equations in which, all things considered, the absolute term seemed abnormally large, while also following the rule of rejecting observations which there was strong reason to suspect *a priori* might be defective from the cause in question, even when not discordant.

40. For the purpose of discussion the observations have been separated into two series, the first comprising all those made before 1750, the second those made after that epoch. The observations of the first series have been discussed very fully in the author's Researches already often quoted. But the work has been carefully revised and such of the additional unknowns as it seemed advisable to include have been added to the equations.

The revision commenced with the Paris school of astronomers, whose work began about 1670. The observations made previous to that epoch, principally by Hevelius, are not so precise as to repay the labor of any further revision. The results have therefore been accepted as they stand in the Researches.

The circumstances under which the original records of the earlier Paris observations were examined and worked up by the author in 1871 are detailed in the former work, as is also the method of determining the clock correction. This is the weakest point in all the earlier observations. The clock correction was determined either by a rude meridian observation with the quadrant, or by equal altitudes, or by a combination of the two, the position of the quadrant being corrected by the altitudes. In this way it may be supposed that a fairly good result is derived for the actual time of determination. But as the clocks were not compensated, the uncertainty continually increased when, as sometimes happened, more than an entire day elapsed between the determinations. On examining his former work the author found no necessity of making a redetermination of the clock corrections. With some possible exceptions the mean time of the observations are taken as found in the Researches. The principal modification made in the absolute terms are due to the application of the correction to the moon's position and to that of the stars. Especially the values of D have been recomputed.

In the first series the number of discordant observations, saying nothing of those seeming to be affected with unduly large errors, is larger in proportion than it should be. It was necessary to exclude a number of discordant equations. Owing to the importance of observations at this epoch the excluded ones are given in a separate list. It is not impossible that if a re-examination of the author's Researches were made several of these equations might be made available by changes in the clock corrections. It will be seen that only two values of the weight are assigned. We might say three, if we include the weight zero given to the discordant observations. These are 1 and 0.3. Greater refinement did not seem to be necessary. Of course the weights are not uniform in their relation to the probable error; all that has been aimed at has been to have them uniform for the groups into which the equations are separated. For the purpose of solution the occultations of this series are divided into five groups, separated by well-marked gaps.

41. *Corrections to the moon's mean longitude for the period 1672–1747.*—From the equations of condition the following equations for the determination of λ were formed according to the method which has been outlined in §39:—

Group.	Mean Epoch.	Equation.	
		″	″ ″
I	1681	$10.9\lambda = -13.9$	$\lambda = -1.3 \pm 1.0$
II	1710	$25.2\lambda = +8.6$	$\lambda = +0.3 \pm 0.5$
III	1727	$7.0\lambda = -1.1$	$\lambda = -0.2 \pm 0.9$
IV	1738	$14.0\lambda = -8.7$	$\lambda = -0.6 \pm 0.4$
V	1747	$13.4\lambda = -8.5$	$\lambda = -0.6 \pm 0.4$

42. To solve for the other unknowns these values of λ were interpolated to a smoothed-off curve, substituted in the equations of condition, and the terms containing them transposed to the second members. But before the normal equations were formed, the equations of condition were modified by multiplying all the coefficients of α_0 and δ_0 by 3, so that, instead of α and δ we have as the unknowns $\frac{1}{3}\alpha$, $\frac{1}{3}\delta$. The equations of condition thus modified are as follows:

GROUP I—1672–1686.

Date.	Place.	Star.	Ph.	κ	$i\theta$	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ε	n	*Wt.*
										″	
1672, Aug. 2	Paris	τ Scorpii	I	+0.96	0.00	−0.02	−0.03	−0.42	+0.06	+1.1	0.3
1676, Feb. 29	Paris	e Leonis	E	+0.52	+0.07	+0.47	−0.21	+1.17	−0.01	+7.2	0.3
Mar. 18	Greenwich	ζ Arietis	I	+0.88	−0.37	−0.48	−0.18	+0.48	−0.29	−8.4	0.3
23	Greenwich	28 Geminor.	I	+0.27	−0.64	−0.69	+0.39	−0.51	−0.56	−6.7	0.3
Nov. 9	Greenwich	π Sagittarii	I	−0.81	−0.43	+0.48	−0.27	+0.45	−0.40	−4.3	0.3
1678, Sept. 24	Greenwich	45 Sagittarii	I	−0.72	−0.14	+0.35	−0.27	+0.42	−0.28	+2.8	0.3
1680, Sept. 13	Greenwich	α Tauri	IB	−0.94	+0.12	+0.28	−0.36	+0.36	+0.28	+0.2	0.3
13	Greenwich	α Tauri	E	+0.89	+0.17	+0.42	+0.60	−0.36	+0.39	−3.7	0.3
Nov. 7	Greenwich	α Tauri	E	+0.99	+0.06	+0.14	+0.54	−0.42	+0.12	+8.1	0.3
1682, Feb. 15	Paris	θ^1 Tauri	I	−0.77	0.00	−0.08	−0.51	+0.48	−0.10	−0.6	1.0
15	Paris	θ^2 Tauri	I	−0.74	0.00	+0.28	−0.24	+0.54	+0.21	+3.7	1.0
Mar 14	Greenwich	γ Tauri	I	−0.66	0.00	−0.19	−0.51	+0.57	−0.21	−3.8	1.0
14	Greenwich	γ Tauri	EB	+0.64	+0.01	−0.33	+0.24	−0.57	−0.26	+0.5	0.3
1683, Feb. 5	Paris	γ Tauri	I	−0.13	−0.21	+0.72	+0.33	+0.48	+0.59	+1.2	1.0
5	Greenwich	γ Tauri	I	−0.15	−0.18	+0.62	+0.15	+0.54	+0.51	+0.3	1.0
Apr. 2	Greenwich	119 Tauri	I	−0.33	−0.24	+0.39	−0.15	+0.33	+0.33	+3.5	1.0
May 4	Greenwich	α Leonis	I	−0.61	−0.75	+0.78	−0.84	−0.39	+0.41	+1.5	1.0
4	Greenwich	α Leonis	EB	+0.76	−0.60	+0.62	−0.03	+0.60	+0.40	+3.2	0.3
1684, Dec. 21	Paris	μ Geminor.	IB	+0.21	+0.94	−0.95	−0.27	+0.06	−0.97	−3.0	1.0
21	Paris	μ Geminor.	E	−0.35	+0.84	−0.85	−0.18	−0.15	−0.80	−4.0	1.0
21	Paris	μ Geminor.	IB	+0.21	+0.94	−0.95	−0.24	+0.06	−0.97	−2.8	1.0
21	Paris	μ Geminor.	E	−0.35	+0.84	−0.85	−0.18	−0.15	−0.80	−3.5	1.0
1685, Oct. 17	Paris	1 Geminor.	IB	+0.99	−0.08	+0.08	+0.09	+0.30	0.00	+0.9	1.0
1686, June 25	Paris	167 B. Leonis	I	+0.55	+0.10	−0.57	+0.51	−0.87	−0.36	+2.2	1.0

GROUP II—1699–1720.

Date.	Place.	Star.	Ph.	κ	$i\theta$	b_0	$\frac{1}{3}a_0$	$\frac{1}{3}d_0$	ϵ	n ″	Wt.
1699, Aug. 18	Paris	α Tauri	IB	−0.46	−0.29	−0.84	−0.57	+0.21	−0.79	−4.5	1.0
18	Paris	α Tauri	E	+0.59	−0.24	−0.72	0.00	−0.27	−0.65	+2.7	1.0
1701, Sept. 22	Paris	α Tauri	IB	+0.25	−0.29	+0.81	+0.42	+0.39	+0.71	+1.4	1.0
22	Paris	α Tauri	E	−0.24	−0.31	+0.82	+0.48	−0.27	+0.78	−0.6	1.0
1705, Aug. 4	Paris	33 Capricor.	IB	−0.56	−0.22	−0.77	−0.87	+0.39	+0.50	+1.0	1.0
Sept. 2	Paris	τ Aquarii	I	−0.78	+0.06	−0.60	−1.14	+0.75	+0.19	−2.2	1.0
2	Paris	τ Aquarii	EB	+0.92	+0.04	−0.33	+0.21	−1.11	+0.21	−4.0	0.3
1706, Jan. 27	Paris	λ Cancri	I	+0.27	+0.21	−0.55	+0.06	−0.42	−0.53	+1.5	1.0
Apr. 21	Paris	η Leonis	I	+0.46	−0.09	−0.59	+0.48	−0.93	−0.37	−3.5	1.0
21	Paris	η Leonis	EB	−0.31	−0.13	−0.84	+0.87	+0.39	−0.48	+0.3	1.0
May 24	Paris	λ Virginis	I	+0.47	−0.85	−0.87	+1.02	−0.81	+0.46	−0.2	1.0
Nov. 17	Paris	ο Piscium	I	−0.90	−0.41	+0.42	−0.09	+1.32	+0.12	+0.7	1.0
1707, Apr. 4	Paris	ρ Arietis	I	−0.38	+0.37	−0.39	+0.75	+0.96	−0.32	+8.0	0.3
Sept. 3	Paris	α Scorpii	I	+0.58	−0.56	−0.82	+0.42	−0.27	+0.75	−6.1	0.3
3	Paris	α Scorpii	EB	−0.63	−0.52	−0.77	+0.48	+0.36	+0.73	−0.9	1.0
1709, Apr. 20	Paris	τ Leonis	I	−0.65	+0.66	+0.66	−1.44	−0.84	+0.17	−2.7	1.0
Sept. 23	Paris	20 Tauri	IB	+0.02	+0.11	−0.47	−0.60	+0.60	−0.37	+3.8	0.5
23	Paris	22 Tauri	E	−0.01	+0.19	−0.85	−0.39	−0.45	−0.71	−3.0	1.0
1710, Dec. 4	Paris	17 Tauri	I	+0.79	+0.04	+0.23	+0.12	+0.63	+0.24	+2.3	1.0
Sept. 30	Paris	η Tauri	IB	+0.52	+0.36	+0.86	+0.48	+0.36	+0.75	−2.9	0.3
30	Paris	η Tauri	E	−0.54	+0.34	+0.84	+0.39	−0.27	+0.66	−0.8	1.0
1712, May 15	Paris	e Leonis	I	−0.08	+0.39	+0.84	−1.29	−0.45	+0.20	−5.0	1.0
1713, Dec. 1	Luxemburg	τ Tauri	I	+0.10	−0.78	−0.80	−0.27	+0.09	−0.70	−0.1	1.0
1714, Mar. 20	Luxemburg	247 B. Tauri	I	−0.08	+0.76	+0.77	+0.03	+0.18	+0.75	+2.6	1.0
21	Paris	ο Tauri	I	+0.11	+0.32	+0.32	−0.21	−0.06	+0.40	−2.4	1.0
21	Luxemburg	ο Tauri	I	+0.11	+0.32	+0.32	−0.21	−0.06	+0.40	−1.2	1.0
Apr. 6	Paris	ξ Sagittarii	E	+0.59	+0.28	−0.32	+0.33	−0.45	+0.23	+2.8	1.0
6	Luxemburg	ξ Sagittarii	E	+0.59	+0.28	−0.32	+0.36	−0.45	+0.23	+2.7	1.0
Sept. 27	Luxemburg	ω Tauri	E	+0.49	−0.38	−0.38	+0.24	−0.27	−0.42	+1.0	1.0
Oct. 2	Luxemburg	α Cancri	E	−0.55	−0.16	−0.42	+0.33	+0.72	−0.40	−2.5	1.0
1715, July 21	Paris	δ Piscium	IB	−0.75	+0.49	+0.61	+0.21	+0.90	+0.14	−5.6	0.3
Aug. 15	Paris	κ Aquarii	IB	−0.30	−0.29	−0.86	−1.05	+0.36	+0.39	−0.8	0.3
15	Paris	κ Aquarii	E	+0.43	−0.24	−0.71	−0.42	−0.81	+0.27	−5.6	0.3
Oct. 9	Paris	κ Aquarii	I	−0.44	−0.23	−0.58	−0.87	+0.72	+0.29	+6.8	0.3
Dec. 30	Paris	κ Aquarii	I	−0.37	−0.19	−0.42	−0.66	+0.78	+0.24	+1.9	1.0
1717, Sept. 25	Paris	α Tauri	IB	−0.67	+0.04	+0.08	−0.33	+0.36	+0.08	−7.2	0.3
25	Paris	α Tauri	E	+0.66	+0.11	+0.22	+0.42	−0.33	+0.19	+2.1	1.0
25	Luxemburg	α Tauri	IB	−0.67	+0.04	+0.08	−0.33	+0.36	+0.08	−3.4	0.3
25	Luxemburg	α Tauri	E	+0.66	+0.11	+0.22	+0.42	−0.33	+0.19	−1.0	1.0
1718, Feb. 9	Luxemburg	α Tauri	I	−0.49	+0.07	+0.19	−0.24	+0.36	+0.17	−0.6	1.0
Sept. 9	Luxemburg	337 B. Aquarii	IB	+0.65	+0.76	+0.76	+0.81	+0.72	−0.19	−0.9	0.5
9	Paris	337 B. Aquarii	IB	+0.64	+0.76	+0.76	+0.63	+0.72	−0.19	−1.5	0.5
1719, Apr. 22	Paris	α Tauri	I	+0.30	+0.02	−0.50	−0.27	+0.42	−0.50	+2.2	1.0
22	Paris	α Tauri	EB	−0.27	+0.02	−0.62	−0.24	−0.36	−0.55	−1.5	1.0
22	Luxemburg	α Tauri	I	+0.30	+0.02	−0.49	−0.27	+0.42	−0.50	+1.3	1.0
Aug. 21	Luxemburg	γ Libræ	I	−0.83	+0.03	−0.26	−0.27	−0.66	+0.18	+2.5	1.0
Oct. 30	Paris	α Tauri	E	−0.63	+0.09	−0.41	−0.24	−0.51	−0.33	−4.8	0.3
Nov. 26	Paris	γ Tauri	IB	+0.68	−0.08	+0.52	+0.36	+0.57	+0.42	−0.3	0.5
1720, Apr. 20	Paris	γ Virginis	I	−0.23	−0.60	+0.96	−1.08	−0.12	−0.11	+2.6	1.0
20	Paris	γ Virginis	EB	+0.41	−0.55	+0.88	−0.69	+0.66	−0.08	−3.7	1.0

GROUP III—1725–1729.

Date.	Place.	Star.	Ph.	κ	$i\theta$	b_0	$\frac{1}{3}a_0$	$\frac{1}{3}d_0$	ϵ	n ″	Wt.
1725, Feb. 19	Luxemburg	A Tauri	I	−0.99	+0.16	−0.17	−0.78	+0.81	−0.22	−2.4	1.0
1727, Feb. 27	St. Petersburg	9 Tauri	I	−0.19	+0.01	−0.02	−0.42	+0.81	−0.02	+6.3	0.3
Sept. 6	Paris	17 Tauri	E	−0.16	−0.25	+0.57	+0.63	−0.60	+0.47	+3.8	1.0
6	Paris	q Tauri	E	−0.15	+0.26	−0.58	−0.21	−0.72	−0.48	−0.9	1.0
6	Paris	20 Tauri	E	−0.19	−0.01	+0.02	+0.30	−0.81	+0.02	+3.7	1.0
1729, Dec. 3	St. Petersburg	17 Tauri	I	+0.91	+0.07	+0.23	+0.15	+0.57	+0.26	+0.8	1.0
3	St. Petersburg	16 Tauri	I	+0.81	−0.14	−0.49	−0.03	+0.54	−0.36	+3.3	1.0
3	St. Petersburg	20 Tauri	I	+0.62	−0.23	−0.75	−0.39	+0.36	−0.59	+0.9	1.0
3	St. Petersburg	23 Tauri	I	+0.27	+0.30	+0.96	+0.45	+0.21	+0.83	+1.3	1.0
3	St. Petersburg	η Tauri	I	+0.82	+0.15	+0.48	+0.27	+0.57	+0.45	+0.3	1.0
3	St. Petersburg	28 Tauri	I	+0.82	+0.15	+0.50	+0.27	+0.51	+0.48	+1.0	1.0
3	St. Petersburg	27 Tauri	I	+0.56	+0.25	+0.81	+0.39	+0.33	+0.73	+1.4	1.0

GROUP IV—1736–1739.

Date.		Place.	Star.	Ph.	κ	$i\theta$	b_0	$\frac{1}{5}\alpha_0$	$\frac{1}{5}\delta_0$	ε	n	Wt.
											″	
1736, Apr.	14	St. Petersburg	α Tauri	I	−0.13	+0.30	+0.62	+0.06	+0.30	+0.56	−3.4	1.0
Aug.	1	St. Petersburg	α Tauri	IB	+0.04	+0.07	+0.16	−0.09	+0.36	+0.15	−4.0	1.0
Oct.	22	St. Petersburg	α Tauri	IB	+0.22	−0.01	−0.02	−0.09	+0.36	−0.01	−3.5	1.0
1737, May	7	St. Petersburg	ξ Leonis	I	−0.61	+0.20	−0.22	−0.21	−0.66	−0.16	−1.3	1.0
July	22	St. Petersburg	θ^1 Tauri	EB	−0.33	−0.10	−0.89	−0.48	−0.27	−0.79	+1.6	1.0
	22	St. Petersburg	θ^2 Tauri	EB	−0.63	−0.06	−0.49	−0.30	−0.45	−0.43	−1.5	1.0
1738, Jan.	2	St. Petersburg	71 Tauri	I	+0.54	−0.03	+0.81	+0.54	+0.33	+0.70	+1.5	1.0
	2	St. Petersburg	θ^1 Tauri	I	+0.93	0.00	−0.03	+0.12	+0.54	−0.08	−0.5	1.0
	2	St. Petersburg	θ^2 Tauri	I	+0.87	−0.01	+0.35	+0.27	+0.54	+0.27	+0.3	1.0
	2	St. Petersburg	264 B. Tauri	I	+0.82	+0.02	−0.47	−0.12	+0.48	−0.48	+2.0	1.0
	2	St. Petersburg	α Tauri	I	+0.54	+0.06	−0.81	−0.30	+0.27	−0.78	−1.4	1.0
	2	St. Petersburg	α Tauri	EB	−0.50	+0.06	−0.84	−0.45	−0.30	−0.76	−0.2	1.0
	2	Paris	α Tauri	I	+0.87	+0.02	−0.33	−0.03	+0.45	−0.35	+0.2	1.0
	2	Paris	α Tauri	EB	−0.90	+0.02	−0.24	−0.27	−0.45	−0.19	+0.5	1.0
Feb.	2	St. Petersburg	f Geminor.	I	+0.19	+0.67	−0.87	+0.15	−0.12	−0.83	−1.6	1.0
Aug.	8	St. Petersburg	71 Tauri	IB	+0.86	−0.11	+0.51	+0.42	+0.51	+0.42	−1.5	1.0
	8	St. Petersburg	α Tauri	IB	+0.64	+0.22	−0.77	−0.33	+0.33	−0.75	+0.1	1.0
Oct.	2	St. Petersburg	α Tauri	IB	+0.80	+0.20	−0.59	−0.21	+0.42	−0.60	+3.2	1.0
	2	St. Petersburg	α Tauri	E	−0.89	+0.14	−0.43	−0.39	−0.51	−0.35	−4.0	1.0
Dec.	23	Paris	α Tauri	I	+0.88	−0.14	+0.36	+0.30	+0.57	+0.28	+2.3	1.0
	23	Paris	α Tauri	EB	−0.78	−0.22	+0.57	+0.21	−0.45	+0.58	−1.6	1.0
1739, Oct.	23	St. Petersburg	85 Geminor.	IB	+0.98	+0.22	−0.22	+0.18	−0.18	−0.28	−0.3	1.0
	23	St. Petersburg	85 Geminor.	E	−1.00	+0.10	−0.10	−0.09	+0.21	−0.02	−3.4	0.3
	24	St. Petersburg	δ Cancri	IB	+0.99	+0.05	−0.05	+0.18	−0.42	−0.11	+3.9	0.3
	24	St. Petersburg	δ Cancri	E	−0.99	−0.07	+0.07	−0.[illegible]	+0.42	+0.13	−5.9	0.3

GROUP V—1746–1747.

Date.		Place.	Star.	Ph.	κ	$i\theta$	b_0	$\frac{1}{5}\alpha_0$	$\frac{1}{5}\delta_0$	ε	n	Wt.
1746, Mar.	26	St. Petersburg	17 Tauri	I	+0.72	+0.04	−0.09	−0.18	+0.75	−0.07	−0.6	1.0
	26	St. Petersburg	16 Tauri	I	+0.42	+0.37	−0.82	−0.66	+0.36	−0.69	+0.4	1.0
	26	St. Petersburg	23 Tauri	I	+0.44	−0.36	+0.79	+0.54	+0.57	+0.67	+1.6	1.0
	26	St. Petersburg	24 Tauri	I	+0.68	−0.14	+0.31	+0.15	+0.78	+0.27	+1.4	1.0
	26	St. Petersburg	η Tauri	I	+0.67	−0.17	+0.37	+0.18	+0.81	+0.32	−0.8	1.0
	26	St. Petersburg	28 Tauri	I	+0.63	−0.22	+0.49	+0.27	+0.75	+0.41	+1.3	1.0
	26	St. Petersburg	Anon. 8	I	+0.70	+0.08	−0.17	−0.18	+0.75	−0.13	+0.4	1.0
	26	St. Petersburg	Anon. 9	I	+0.71	+0.07	−0.15	−0.21	+0.78	−0.12	+0.9	1.0
	26	St. Petersburg	Anon. 4	I	+0.35	+0.39	−0.87	−0.69	+0.30	−0.72	+0.2	1.0
	26	St. Petersburg	Anon. 10	I	+0.66	+0.17	−0.38	−0.36	+0.72	−0.30	−0.2	1.0
	26	St. Petersburg	Anon. 15	I	+0.70	−0.11	+0.25	+0.09	+0.81	+0.21	+0.2	1.0
	26	St. Petersburg	Anon. 18	I	+0.70	−0.12	+0.22	+0.06	+0.81	+0.18	−1.4	1.0
	26	St. Petersburg	Anon. 29	I	+0.65	+0.20	−0.44	−0.36	+0.60	−0.37	+1.9	1.0
1747, Jan.	20	St. Petersburg	16 Tauri	I	+0.50	−0.20	+0.87	+0.57	+0.45	+0.74	−0.9	1.0
	20	St. Petersburg	q Tauri	I	+0.96	−0.05	+0.25	+0.18	+0.69	+0.24	+0.1	1.0
	20	St. Petersburg	21 Tauri	I	+0.99	0.00	0.00	0.00	+0.72	+0.02	−2.9	1.0
	20	St. Petersburg	20 Tauri	I	+0.70	−0.13	+0.71	+0.48	+0.57	+0.61	−3.3	1.0
	20	St. Petersburg	22 Tauri	I	+0.98	−0.02	+0.12	+0.09	+0.72	+0.11	−0.6	1.0
July	30	St. Petersburg	Anon. 4	E	−0.84	−0.01	+0.48	+0.33	−0.57	+0.34	+0.1	1.0
	30	St. Petersburg	20 Tauri	E	−0.86	−0.01	+0.42	+0.27	−0.60	+0.32	+0.8	1.0
	30	St. Petersburg	q Tauri	E	−0.94	0.00	−0.14	−0.09	−0.69	−0.16	+1.2	1.0

43. From these equations of condition the following normal equations have been formed in the usual way:

Group.	Year.	κ	$i\theta$	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ϵ	$[n]$
Normal equations in κ.								″
I	1681	+ 5.75	+0.29	− 1.00	+ 2.31	− 1.58	−0.33	= + 2.80
II	1710	+10.86	+0.37	+ 0.23	+ 5.19	− 3.85	−0.77	+ 6.19
III	1727	+ 4.67	+0.11	+ 1.03	+ 1.32	+ 1.83	+1.18	+ 7.00
IV	1738	+11.48	+0.40	+ 0.24	+ 2.02	+ 5.22	−0.43	+13.52
V	1747	+11.08	−0.23	+ 0.65	− 0.22	+10.01	+0.75	− 5.48
Normal equations in $i\theta$.								
I	1681		+4.24	− 4.16	− 0.14	− 0.38	−3.66	= −11.67
II	1710		+5.70	+ 3.40	− 0.47	− 0.99	+0.78	− 1.02
III	1727		+0.42	+ 0.58	+ 0.09	+ 0.29	+0.50	− 1.25
IV	1738		+0.83	− 1.07	− 0.20	− 0.05	−1.05	− 2.44
V	1747		+0.68	− 1.63	− 1.17	− 0.36	−1.38	+ 0.48
Normal equations in b_0.								
I	1681			+ 5.98	+ 0.09	+ 1.60	+4.97	= +19.79
II	1710			+15.97	− 1.03	+ 1.44	+5.46	+10.51
III	1727			+ 3.60	+ 1.97	+ 0.52	+3.12	+ 4.04
IV	1738			+ 6.67	+ 2.75	+ 1.13	+6.15	− 1.28
V	1747			+ 4.79	+ 3.40	+ 0.96	+3.99	− 2.60
Normal equations in $\frac{1}{3}\alpha_0$.								
I	1681				+ 2.27	− 0.98	+0.64	= + 3.97
II	1710				+14.24	− 1.27	+1.21	+11.92
III	1727				+ 1.85	− 0.76	+1.76	+ 5.92
IV	1738				+ 1.80	+ 1.06	+2.41	+ 2.29
V	1747				+ 2.48	− 0.05	+2.83	− 1.92
Normal equations in $\frac{1}{3}\delta_0$.								
I	1681					+ 3.57	+0.89	= − 1.89
II	1710					+12.93	+0.03	+11.37
III	1727					+ 3.87	+0.52	− 1.07
IV	1738					+ 4.02	+0.73	+ 1.78
V	1747					+ 9.50	+1.00	− 2.99
Normal equations in ϵ.								
I	1681						+4.60	= +17.50
II	1710						+8.49	+ 1.15
III	1727						+2.70	+ 3.99
IV	1738						+5.73	− 2.04
V	1747						+3.36	− 2.36

It will be seen that, owing to the irregular way in which the observations are scattered around the moon's orbit, the coefficients of the unknowns in the normal equations are very irregular, showing that a solution of each group separately will lead to results of little weight. On the other hand, if we combine the five sets of normal equations into a single one, the true values of the unknowns will not be the same in all the equations, because they vary with the time. Of course, one way of apparently evading this difficulty would be to multiply by the time to include its coefficient as additional unknowns, but the variations thus obtained would be very uncertain compared with those to be subsequently reached through all the occultations. The easiest way of surmounting the difficulty is the following:

Let x be any one of the unknowns. Let x_0 and x_1 be the values of x at the respective epochs 1850 and an arbitrary epoch near the mean of all the groups under consideration, say 1720. The value of x at an interval τ after 1720 will then be

$$x = x_1\left(1 - \frac{\tau}{1.30}\right) + \frac{\tau}{1.30}\,x_0.$$

The value of x_0 is so small that, τ being a small factor sometimes positive and sometimes negative, the last term of this expression may be dropped and regarded as belonging to the accidental errors, the magnitude of which it will not increase in any appreciable degree. We may therefore replace x by the unknown x_1, its value at the mean epoch. The expressions to be used then become

$$\begin{array}{rl}
\text{Group I} & x=1.28\,x_1 \\
\text{II} & x=1.05\,x_1 \\
\text{III} & x=0.94\,x_1 \\
\text{IV} & x=0.86\,x_1 \\
\text{V} & x=0.79\,x_1
\end{array}$$

44. We thus form a single set of normal equations by multiplying the terms of the partial normals already given by the appropriate factors and adding. Doing this, the final normals for the values of the unknowns at the mean epoch become:

x	$i\theta$	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ϵ	$\{n\}$
						''
+40.86	+ 1.15	+ 0.10	+12.01	+ 4.86	− 0.21	+23.96
+ 1.15	+14.62	− 4.37	− 1.55	− 1.71	− 6.34	−18.91
+ 0.10	− 4.37	+38.46	+ 4.90	+ 6.10	+23.93	+37.02
+12.01	− 1.55	+ 4.90	+23.88	− 2.93	+ 7.45	+23.59
+ 4.86	− 1.71	+ 6.10	− 2.93	+32.34	+ 3.11	+ 7.68
− 0.21	− 6.34	+23.93	+ 7.45	+ 3.11	+25.58	+23.75

On account of the correlation between b_0 and ϵ, we shall neglect b_0 in this preliminary solution. Putting therefore $b_0=0$, and solving, we derive:

$$\left.\begin{aligned}
x=-2e\,\delta\pi &= +0.44'' \\
i\theta=\sin i\,\delta\Omega &= -1.03 \\
\tfrac{1}{3}\alpha_0 &= +0.54 \\
\tfrac{1}{3}\delta_0 &= +0.12 \\
\epsilon &= +0.50
\end{aligned}\right\}\ \text{Epoch 1720.}$$

CHAPTER IX.

EQUATIONS OF CONDITION, 1753-1908.

SECTION I.

GROUP VI—1753-1779.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1753, Apr. 19	Greenwich	β Scorpii	IB	−0.61	+0.21	−0.72	+0.30	+0.78	−0.12	−0.08	−0.64	+0.27	−2.4	−3.0
Aug. 5	Greenwich	8 Libræ	I	−0.13	−0.03	+0.97	−0.19	−0.99	+0.19	−0.04	+0.65	−0.14	−3.9	−4.0
Oct. 5	Greenwich	16 B. Capricor.	I	−0.74	+0.73	−0.03	−0.57	−0.58	−0.10	+0.16	+0.53	−0.79	+2.3	+1.6
5	Greenwich	β Capricor.	I	−0.77	+0.77	−0.03	−0.52	−0.52	−0.08	+0.16	+0.48	−0.83	+3.5	+2.7
5	Greenwich	β Capricor.	EB	+0.86	−0.85	−0.02	−0.30	−0.30	−0.07	−0.20	+0.22	+0.89	−2.5	−2.0
1754, Apr. 2	Greenwich	κ Cancri	I	−1.09	−0.90	0.00	+0.01	−0.01	−0.18	−0.22	−0.06	−0.79	−2.6	−3.7
Nov. 21	Greenwich	ρ Aquarii	I	−0.92	+0.72	+0.05	+0.04	+0.06	+0.06	+0.11	−0.11	−1.00	+2.3	+1.4
1757, Apr. 3	Greenwich	γ Virginis	IB	−0.65	+0.06	−0.53	+0.55	+0.76	−0.29	−0.16	+0.07	−0.06	+6.1	+5.5
July 30	Greenwich	19 Capricor.	IB	−1.15	−0.98	+0.13	+0.01	+0.13	−0.19	+0.16	−0.18	−0.03	+2.4	+1.4
1758, Feb. 17	Greenwich	ν Geminor.	I	−0.85	+0.54	+0.33	+0.19	−0.38	−0.01	+0.05	−0.45	−0.82	+2.3	+1.5
1761, Dec. 10	Greenwich	θ² Tauri	I	−0.73	+0.45	−0.09	+0.74	+0.74	0.00	+0.12	+0.64	−0.15	+1.4	+0.7
1764, Feb. 20	Greenwich	α Virginis	IB	−1.11	−0.99	+0.01	0.00	+0.01	−0.24	−0.45	−0.01	+0.74	−6.4	−7.2
20	Greenwich	α Virginis	E	+1.05	+0.94	−0.31	+0.07	−0.31	+0.35	+0.40	+0.12	−0.70	−4.9	−4.6
1765, Feb. 4	Greenwich	γ Cancri	I	−0.96	+0.45	−0.04	−0.04	−0.06	−0.04	−0.29	−0.03	−0.14	+1.2	+0.5
Sept. 25	Greenwich	δ Capricor.	I	−1.04	−0.70	−0.20	−0.06	+0.21	−0.10	+0.40	−0.11	−0.73	+0.1	−0.6
Oct. 2	Greenwich	q Tauri	IB	−0.84	+0.71	−0.07	+0.41	+0.42	+0.08	+0.23	+0.39	+0.58	−2.6	−3.2
2	Greenwich	18 Tauri	IB	−0.42	+0.35	+0.15	−0.88	−0.90	−0.21	+0.08	−0.90	+0.30	−5.7	−6.0
1766, Sept. 22	Greenwich	17 Tauri	IB	−0.51	+0.06	+0.13	+0.85	+0.86	+0.31	+0.13	+0.76	+0.37	−3.3	−3.6
22	Greenwich	20 Tauri	IB	−0.98	+0.12	+0.02	+0.15	+0.15	−0.04	+0.23	+0.18	+0.71	−0.1	−0.7
1767, Sept. 12	Greenwich	η Tauri	IB	−1.03	−0.51	+0.10	+0.19	+0.22	−0.09	+0.18	+0.26	+0.81	−3.3	−3.8
12	Greenwich	27 Tauri	IB	−0.61	−0.31	+0.39	+0.71	+0.88	+0.06	+0.10	+0.63	+0.50	−0.6	−0.9
12	Greenwich	η Tauri	E	+0.97	+0.49	+0.18	+0.33	+0.38	+0.16	+0.16	+0.25	+0.78	+1.2	+1.3
1768, Jan. 27	Greenwich	23 Tauri	I	−0.96	−0.64	−0.22	−0.31	−0.38	−0.15	+0.16	−0.32	−0.86	−0.5	−1.0
27	Greenwich	η Tauri	I	−0.24	−0.17	−0.50	−0.78	−0.97	−0.15	+0.03	−0.80	−0.22	−0.1	−0.2
27	Greenwich	η Tauri	E	+0.03	+0.01	−0.60	−0.80	−1.00	−0.13	−0.02	−0.85	+0.02	+1.1	+1.1
1769, Sept. 15	Greenwich	16 Piscium	IB	−0.86	−0.20	−0.02	−0.58	−0.58	−0.33	+0.28	+0.13	+0.02	−3.8	−4.1
20	Greenwich	67 Tauri	IB	−1.01	−0.91	−0.32	+0.15	−0.36	−0.17	+0.08	−0.25	+0.82	+0.8	+0.4
20	Greenwich	ε Tauri	IB	−0.77	−0.71	−0.68	−0.18	−0.70	−0.16	+0.06	−0.57	+0.67	+2.4	+2.1
20	Greenwich	κ Tauri	E	+0.91	+0.83	+0.52	−0.11	−0.53	+0.08	−0.08	−0.55	−0.75	+6.6	+6.6
20	Greenwich	67 Tauri	E	+1.06	+0.96	+0.16	−0.04	−0.17	+0.13	−0.08	−0.24	−0.87	+3.3	+3.3
25	Greenwich	h Leonis	IB	−0.72	−0.35	+0.36	+0.65	−0.74	+0.13	−0.29	−0.40	+0.52	+1.2	+0.9
Nov. 18	Greenwich	α Cancri	E	+0.45	+0.30	+0.52	−0.74	+0.91	−0.19	+0.18	+0.63	−0.40	+4.4	+4.4
1770, Apr. 7	Greenwich	c Leonis	I	−1.02	−0.33	+0.04	+0.16	−0.16	−0.05	−0.38	+0.08	−0.51	−0.3	−0.6
28	Greenwich	ζ Tauri	I	−1.10	−0.96	+0.02	0.00	+0.02	−0.18	−0.02	+0.10	−0.70	+1.1	+0.8
July 19	Greenwich	ζ Tauri	E	+1.10	+0.90	−0.22	+0.07	−0.23	−0.21	+0.0[illegible]	−0.30	−0.54	+2.2	+2.0
1771, July 4	Greenwich	δ Piscium	IB	−0.81	+0.56	−0.40	−0.27	−0.48	−0.13	+0.25	−0.05	+0.85	−2.7	−2.9
4	Greenwich	δ Piscium	E	+0.86	−0.61	−0.31	−0.20	−0.37	−0.13	−0.32	−0.11	−0.91	+2.0	+1.8
Sept. 18	Greenwich	β Capricor.	I	−0.69	−0.60	+0.10	−0.65	−0.66	−0.14	+0.15	+0.67	−0.62	+3.4	+3.3
Dec. 24	Greenwich	κ Cancri	E	+1.10	+0.86	0.00	+0.01	−0.01	+0.18	+0.26	−0.06	−0.65	+2.2	+1.9
1772, May 15	Greenwich	8 Libræ	I	−1.00	−0.71	+0.43	−0.11	−0.44	−0.07	−0.20	+0.35	−0.21	+0.5	+0.4
15	Greenwich	α Libræ	I	−1.05	−0.75	+0.32	−0.08	−0.33	−0.10	−0.21	+0.28	−0.21	+1.3	+1.2
Aug. 17	Greenwich	ζ Piscium	E	+0.74	−0.83	−0.56	−0.06	−0.57	−0.20	−0.25	−0.20	−0.64	+2.4	+2.1
Sept. 7	Greenwich	β Capricor.	I	−0.74	+0.[illegible]5	−0.11	−0.62	−0.63	−0.14	+0.14	+0.54	−0.59	−3.5	−3.6
1773, Feb. 6	Greenwich	α Cancri	I	−1.02	−0.21	−0.10	−0.21	+0.24	−0.18	−0.21	+0.22	−0.05	−0.2	−0.2
Sept. 7	Greenwich	α Tauri	IB	−0.62	+0.66	+0.31	−0.66	+0.73	+0.10	+0.09	+0.69	+0.68	−0.3	−0.3
Nov. 1	Greenwich	α Tauri	IB	−0.82	+0.90	+0.16	−0.37	+0.40	+0.07	+0.12	+0.38	+0.40	+1.1	+1.1
1774, Nov. 18	Greenwich	α Tauri	E	+0.92	−0.77	0.00	+0.11	+0.11	−0.01	−0.16	−0.07	−0.07	−2.1	−2.6
1775, Aug. 1	Greenwich	γ Virginis	EB	+0.83	−0.42	+0.33	−0.30	−0.44	+0.12	+0.27	+0.09	+0.81	−3.6	−4.0
Dec. 12	Greenwich	α Leonis	E	+0.76	−0.84	+0.53	−0.07	−0.54	+0.07	+0.17	−0.24	−0.75	−3.0	−3.5
1776, Jan. 29	Greenwich	α Tauri	I	−0.97	−0.04	−0.02	−0.06	+0.07	−0.05	+0.19	0.00	−0.93	+3.1	+3.3
Mar. 30	Greenwich	α Leonis	I	−0.81	+0.88	+0.41	−0.10	−0.42	+0.15	−0.23	−0.26	−0.62	+2.4	+2.6
Apr. 6	Greenwich	γ Libræ	IB	−0.49	+0.11	−0.14	−0.85	−0.86	+0.19	−0.16	+0.66	+0.34	−2.3	−2.2
1777, Nov. 16	Greenwich	ζ Tauri	IB	−1.12	−0.86	−0.08	−0.03	+0.09	−0.20	+0.14	0.00	+0.33	−0.5	−0.3
16	Greenwich	ζ Tauri	E	+1.08	+0.83	−0.28	−0.10	+0.30	+0.24	−0.13	+0.37	−0.32	+1.9	+1.3
1778, Feb. 7	Greenwich	μ Geminor.	I	−0.75	−0.57	+0.71	+0.05	−0.71	−0.16	+0.05	−0.78	−0.50	−0.3	−0.1
Dec. 31	Greenwich	ι Tauri	I	−0.97	−0.84	+0.49	+0.06	−0.49	−0.26	+0.17	−0.56	−0.36	+1.3	+1.5
1779, Feb. 27	Greenwich	γ Cancri	I	−1.08	−0.88	+0.14	−0.16	−0.21	−0.13	−0.16	−0.26	−0.55	+2.0	+2.[illegible]
Oct. 30	Greenwich	1 Geminor.	E	+0.88	+0.80	−0.38	+0.42	+0.57	+0.08	+0.07	+0.62	−0.80	+0.2	−0.3
Dec. 22	Greenwich	132 Tauri	I	−0.77	−0.51	−0.66	+0.28	+0.72	−0.06	+0.08	+0.66	−0.06	+0.5	+0.7

GROUP VII—1783–1801.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1783, Feb. 9	Greenwich	q Tauri	I	−0.61	−0.61	+0.43	−0.60	−0.74	−0.20	+0.16	−0.64	−0.66	+1.1	+1.2
9	Greenwich	18 Tauri	I	−0.58	−0.58	+0.45	−0.62	−0.77	−0.19	+0.14	−0.66	−0.63	−1.6	−1.5
May 16	Greenwich	π Scorpii	IB	−1.14	−0.89	+0.02	+0.04	−0.05	−0.22	−0.26	+0.05	+0.15	+0.6	+0.7
Oct. 7	Greenwich	φ Aquarii	I	−0.72	−0.38	−0.73	−0.03	+0.73	+0.20	+0.39	−0.31	−0.38	−2.4	−2.3
Dec 6	Greenwich	17 Tauri	I	−0.83	+0.46	−0.14	+0.45	+0.47	+0.08	+0.09	+0.41	−0.35	+0.6	+0.7
6	Greenwich	q Tauri	I	−0.25	+0.14	+0.28	−0.92	−0.96	−0.18	+0.03	−0.80	−0.09	−3.1	−3.1
30	Greenwich	δ Piscium	I	−0.87	−0.30	+0.43	−0.24	−0.49	−0.3[illegible]	+0.46	−0.09	−0.88	+1.6	+1.7
30	Greenwich	δ Piscium	EB	+0.95	+0.33	+0.26	−0.15	−0.30	−0.03	−0.46	−0.09	+0.96	−4.6	−5.1
1784, July 2	Greenwich	τ Sagittarii	IB	−0.90	+0.68	0.39	−0.48	+0.62	−0.10	+0.12	−0.57	+0.04	−1.8	−1.7
1785, Apr. 11	Greenwich	q Tauri	I	−1.05	−0.41	−0.03	−0.20	−0.20	−0.19	+0.20	−0.12	−0.50	+0.6	+0.6
11	Greenwich	17 Tauri	I	−0.12	−0.05	+0.16	+0.98	+0.99	+0.19	+0.04	+0.84	−0.07	+0.5	+0.5
11	Greenwich	20 Tauri	I	−1.05	−0.41	+0.04	+0.22	+0.22	−0.11	+0.20	[illegible]4	−0.50	−2.0	−2.0
11	Greenwich	21 Tauri	I	−0.94	−0.37	−0.08	−0.47	−0.48	−0.23	+0.18	[illegible]3	−0.44	+0.8	+0.8
11	Greenwich	22 Tauri	I	−1.00	−0.39	−0.06	−0.36	−0.36	−0.2[illegible]	+0.19	[illegible]0.34	−0.47	+0.2	+0.2
June 22	Greenwich	φ Sagittarii	IB	−1.04	−0.29	+0.07	+0.05	−0.09	−0.14	+0.12	[illegible]0.14	−0.16	−2.2	−2.2
Aug. 16	Greenwich	φ Sagittarii	EB	+1.02	+0.43	+0.17	+0.11	−0.20	+0.10	−0.14	+0.13	+0.66	−4.2	−4.6
1786, Mar. 5	Greenwich	17 Tauri	I	−1.00	−0.80	+0.17	+0.35	+0.39	−0.08	+0.18	+0.40	−0.84	−1.3	−1.3
5	Greenwich	16 Tauri	I	−1.04	−0.84	−0.11	−0.23	−0.26	−0.19	+0.18	−0.15	−0.90	−1.2	−1.2
5	Greenwich	q Tauri	I	−0.56	−0.45	−0.38	−0.77	−0.86	−0.24	+0.08	−0.69	−0.50	+1.6	+1.6
5	Greenwich	20 Tauri	I	−0.99	−0.79	−0.18	−0.36	−0.40	−0.21	+0.15	−0.27	−0.84	−0.3	−0.3
Nov. 12	Greenwich	π Leonis	IB	−0.92	−0.05	+0.26	−0.21	+0.34	−0.20	−0.34	+0.27	+0.94	−8.4	−8.4
12	Greenwich	π Leonis	E	+0.97	+0.05	+0.04	−0.03	+0.05	+0.05	+0.39	−0.05	−1.00	+3.2	+2.9
Dec. 9	Greenwich	ξ Leonis	IB	−0.58	−0.14	−0.70	+0.44	−0.82	+0.22	−0.26	−0.48	+0.44	−4.5	−4.5
9	Greenwich	ξ Leonis	E	+0.62	+0.14	−0.67	+0.42	−0.79	+0.35	+0.16	−0.56	−0.47	+2.5	+2.3
1787, Nov. 26	Greenwich	η Geminor.	IB	−1.14	−1.00	+0.06	0.00	+0.07	−0.23	−0.09	+0.16	+0.36	−3.4	−3.5
26	Greenwich	η Geminor.	E	+1.13	+0.99	+0.13	−0.01	+0.13	+0.21	+0.08	+0.04	−0.36	+2.9	+2.7
26	Greenwich	μ Geminor.	IB	−0.35	−0.31	−0.95	+0.09	−0.95	+0.03	−0.04	−0.[illegible]9	+0.13	−0.4	−0.4
26	Greenwich	μ Geminor.	E	+0.15	+0.14	−0.99	+0.10	−0.99	+0.11	+0.01	−1.0[illegible]	−0.07	−0.5	−0.5
1788, Oct. 18	Greenwich	i Tauri	IB	−0.95	−0.56	+0.38	−0.02	+0.38	−0.10	+0.01	+0.41	+0.70	−4.3	−4.5
18	Greenwich	i Tauri	E	+0.86	+0.50	+0.56	−0.04	+0.56	+0.10	−0.01	+0.68	−0.62	+0.7	+0.6
Nov. 15	Greenwich	ζ Tauri	IB	−0.63	−0.39	+0.79	−0.18	+0.81	−0.11	−0.02	+0.85	+0.31	−4.2	−4.3
15	Greenwich	ζ Tauri	E	+0.46	+0.28	+0.88	−0.21	+0.91	+0.05	+0.02	+0.87	−0.21	−0.7	−0.7
1789, Nov. 9	Greenwich	κ Cancri	E	+0.69	+0.53	−0.09	+0.75	−0.76	+0.29	+0.15	−0.59	−0.65	+0.1	+0.1
1790, Mar. 5	Greenwich	κ Libræ	I	−0.60	−0.41	−0.81	+0.16	+0.83	−0.19	−0.07	−0.64	+0.53	−3.0	−3.3
Aug. 17	Greenwich	ν Scorpii	I	−0.69	−0.55	+0.67	−0.35	−0.76	0.00	−0.08	+0.71	−0.65	−1.1	−1.4
Oct. 15	Greenwich	[illegible] Capricor.	I	−0.67	−0.08	0.00	−0.73	−0.73	−0.18	+0.13	+0.65	−0.67	+2.5	+2.2
Nov. 17	Greenwich	ι Piscium	I	−0.85	+0.88	−0.30	−0.08	−0.31	−0.04	+0.28	−0.08	−0.68	+1.4	+1.0
1791, Mar. 16	Greenwich	κ Cancri	I	−1.01	−0.04	+0.04	+0.11	−0.12	−0.07	−0.24	−0.04	−0.55	−0.1	−0.7
Apr. 7	Greenwich	δ Tauri	I	−0.84	+0.89	−0.26	+0.24	−0.35	0.00	+0.09	−0.14	−0.70	+1.5	+1.0
June 12	Greenwich	λ Virginis	I	−0.84	−0.72	+0.63	−0.17	−0.65	+0.03	−0.21	+0.41	−0.52	−1.3	−1.8
12	Greenwich	λ Virginis	I	−0.82	−0.70	+0.65	−0.18	−0.67	+0.03	−0.20	+0.42	−0.51	−0.7	−1.2
1792, Mar. 27	Greenwich	α Tauri	I	−0.56	+0.56	+0.35	−0.71	+0.79	+0.09	+0.07	+0.74	−0.55	+0.3	−0.1
1793, Apr. 19	Camb., Eng.	ξ Leonis	I	−0.43	+0.49	−0.80	−0.36	+0.88	−0.16	−0.08	+0.56	−0.42	+3.0	+2.6
19	Greenwich	ξ Leonis	I	−0.40	+0.45	−0.82	−0.36	+0.90	−0.17	−0.08	+0.53	−0.38	+2.1	+1.7
1794, Mar. 5	Camb., Eng.	μ Ceti	I	−1.08	−0.71	−0.02	+0.06	−0.06	+0.22	+0.28	−0.02	−0.75	+2.3	+1.2
5	Greenwich	μ Ceti	I	−1.08	−0.70	+0.03	−0.09	+0.10	−0.11	+0.30	0.00	−0.74	+6.9	+5.8
7	Camb., Eng.	α Tauri	I	−0.50	−0.16	+0.17	+0.86	−0.87	−0.23	+0.08	−0.84	−0.48	0.0	−0.5
Aug. 4	Greenwich	γ Libræ	I	−0.94	+0.62	−0.03	−0.03	−0.03	−0.01	−0.25	−0.01	−0.97	+2.0	+1.1
Nov. 8	Camb., Eng.	α Tauri	IB	−1.10	−0.70	−0.07	+0.17	+0.19	−0.17	+0.19	+0.12	+0.21	+2.4	+1.3
8	Camb., Eng.	α Tauri	E	+1.02	+0.65	+0.16	+0.37	−0.41	+0.12	−0.18	−0.31	−0.20	−1.2	−0.4
8	Greenwich	α Tauri	E	+1.04	+0.66	−0.14	−0.33	+0.36	+0.25	−0.17	+0.39	−0.20	−6.2	−5.4
Dec. 18	Greenwich	γ Libræ	E	+0.91	−0.82	−0.03	−0.16	−0.16	+0.05	+0.25	+0.10	−0.54	−2.1	−1.4
18	Camb., Eng.	γ Libræ	E	+0.91	−0.81	−0.04	+0.19	−0.19	+0.05	+0.25	−0.13	−0.53	−0.6	+0.1
1795, Aug. 6	Greenwich	ξ² Ceti	IB	−0.31	−0.28	+0.77	−0.95	−0.96	−0.36	+0.04	−0.59	+0.29	−1.5	−1.9
Oct. 6	Greenwich	δ Cancri	E	+0.84	+0.34	−0.53	+0.10	+0.54	−0.02	+0.12	+0.49	−0.81	0.0	+0.7
6	Camb., Eng.	δ Cancri	E	+0.86	+0.35	−0.51	+0.09	+0.52	−0.01	+0.13	+0.47	−0.88	−1.2	−0.4
Nov. 24	Greenwich	μ Ceti	I	−1.04	−0.86	+0.12	+0.42	−0.44	−0.34	+0.27	−0.36	−0.37	−0.4	−1.6
1797, Mar. 17	Camb., Eng.	ν Scorpii	E	+0.70	−0.41	−0.61	−0.29	−0.67	+0.20	+0.18	+0.66	−0.65	−2.0	−1.3
Dec. 25	Camb., Eng.	33 Piscium	I	−0.81	+0.72	−0.11	−0.44	−0.45	−0.18	+0.33	−0.07	−0.89	+3.4	+2.3
25	Greenwich	33 Piscium	I	−0.82	+0.73	+0.11	+0.43	−0.44	−0.18	+0.33	−0.07	−0.90	+3.2	+2.1
1798, Aug. 8	Greenwich	ε Geminor.	E	+0.99	+0.39	−0.29	+0.22	+0.36	+0.13	−0.02	+0.43	−0.51	−0.7	+0.5
Oct. 5	Camb., Eng.	η Leonis	IB	−0.90	−0.72	+0.03	−0.59	−0.59	+0.03	−0.30	−0.36	+0.57	−3.0	−4.3
1799, Apr. 10	Camb., Eng.	125 Tauri	I	−0.94	+0.28	−0.04	+0.03	+0.05	−0.02	+0.12	−0.02	−0.94	+3.2	+1.7
10	Greenwich	125 Tauri	I	−0.94	+0.28	−0.10	+0.07	+0.12	−0.02	+0.12	+0.05	−0.94	+3.2	+1.7
21	Greenwich	δ Scorpii	E	+1.10	+0.77	−0.18	+0.04	−0.19	+0.27	+0.28	+0.22	−0.40	+1.3	+2.6
1800, May 5	Greenwich	η Virginis	I	−0.73	−0.42	+0.69	+0.32	+0.76	−0.47	−0.23	−0.05	−0.40	+3.1	+1.9
July 4	Greenwich	43 Ophiuchi	I	−0.90	−0.77	−0.35	+0.50	−0.61	−0.11	−0.10	+0.57	−0.30	+2.6	+[illegible]1
Sept. 30	Camb., Eng.	ψ Aquarii	I	−0.77	−0.11	−0.52	−0.37	+0.64	+0.19	+0.41	−0.22	−0.40	+3.3	+2.0
Nov. 26	Camb., Eng.	ζ Piscium	I	−0.55	+0.19	+0.81	−0.03	−0.81	−0.39	+0.18	−0.26	−0.48	+1.8	+0.9
26	Greenwich	ζ Piscium	I	−0.60	+0.21	+0.77	−0.03	−0.77	−0.39	+0.20	−0.21	−0.51	+1.6	+0.6

GROUP VII—1783-1801—Continued.

Date.		Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
														″	″
1800, Nov.	26	Greenwich	ζ Pisc.(comp.)	I	−0.60	+0.21	+0.77	−0.03	−0.77	−0.39	+0.20	−0.21	−0.51	+1.6	+0.6
1801, Jan.	5	Greenwich	β Virginis	IB	−0.65	−0.05	+0.70	+0.25	+0.74	−0.39	−0.23	+0.06	+0.64	+1.1	0.0
	5	Greenwich	β Virginis	E	+0.85	+0.06	+0.48	+0.17	+0.51	−0.16	+0.45	+0.05	−0.83	−1.2	−0.1
Mar.	30	Camb., Eng.	α Virginis	IB	−0.97	−0.31	+0.35	−0.07	+0.36	−0.31	−0.38	−0.14	+0.25	−2.0	−3.6
	30	Greenwich	α Virginis	IB	−0.96	−0.31	+0.37	−0.07	+0.38	−0.31	−0.39	−0.14	+0.25	+2.2	+0.6
	30	Greenwich	α Virginis	E	+1.03	+0.33	+0.13	−0.03	+0.14	+0.09	+0.47	−0.05	−0.28	+0.8	+2.2
	30	Camb., Eng.	α Virginis	E	+1.03	+0.33	+0.12	−0.03	+0.13	+0.10	+0.46	−0.04	−0.28	−0.2	+1.2
Apr.	24	Greenwich	σ Leonis	I	−0.85	+0.26	−0.45	−0.19	−0.48	+0.15	−0.44	−0.13	−0.61	+1.6	+0.2
May	21	Camb., Eng.	χ Leonis	I	−0.77	+0.33	+0.54	+0.25	+0.59	−0.32	−0.30	+0.42	−0.76	+3.1	+1.8
	24	Greenwich	α Virginis	I	−0.94	−0.24	+0.41	−0.10	+0.42	−0.33	−0.37	−0.16	−0.51	+2.6	+1.0
	24	Camb., Eng.	α Virginis	I	−0.95	−0.24	+0.39	−0.10	[illegible]	−0.33	−0.37	−0.15	−0.51	+2.7	+1.1
	24	Camb., Eng.	α Virginis	EB	+1.04	+0.27	+0.10	−0.03	+0.10	+0.12	+0.47	−0.04	+0.55	−3.6	−2.2

GROUP VIII 1801-1820.

Date.		Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
1801, Oct.	23	Camb., Eng.	η Tauri	IB	−0.82	+0.33	+0.28	−0.46	−0.53	−0.18	+0.20	−0.45	+0.28	−0.5	−1.9
	23	Greenwich	24 Tauri	IB	−0.79	+0.32	+0.30	−0.50	−0.59	−0.20	−0.19	−0.54	+0.27	−2.0	−3.3
	23	Greenwich	η Tauri	IB	−0.84	+0.34	+0.26	−0.43	−0.51	−0.17	+0.21	−0.44	+0.29	+1.9	+0.5
	23	Greenwich	23 Tauri	E	+0.97	−0.39	+0.04	−0.07	−0.08	+0.05	−0.26	−0.06	−0.33	−1.0	+0.3
	23	Greenwich	27 Tauri	IB	−0.94	+0.38	−0.13	+0.22	+0.26	0.00	+0.26	+0.22	+0.32	−0.6	−2.2
	23	Greenwich	28 Tauri	IB	−0.97	+0.39	−0.02	+0.03	+0.04	[illegible]	[illegible]	[illegible]	+0.33	−1.0	−2.6
	23	Camb., Eng.	η Tauri	E	+0.93	−0.37	+0.15	−0.25	−0.29	[illegible]	[illegible]	[illegible]	−0.32	−1.4	−0.1
	23	Camb., Eng.	27 Tauri	E	+0.88	−0.35	−0.21	+0.37	+0.43	[illegible]	[illegible]	[illegible]	−0.30	−1.3	0.0
	23	Camb., Eng.	28 Tauri	E	+0.96	−0.38	+0.07	+0.12	+0.14	+0.09	0.24	+0.11	−0.33	−5.0	−3.6
	23	Greenwich	27 Tauri	E	+0.86	−0.34	−0.23	+0.40	+0.46	+0.16	−0.20	+0.39	−0.29	−2.4	−1.2
	23	Greenwich	28 Tauri	E	+0.95	−0.38	−0.09	+0.15	+0.17	+0.09	−0.25	+0.15	−0.32	−4.4	−3.1
1802, Mar.	14	Greenwich	γ Cancri	I	−0.89	+0.97	+0.08	+0.08	+0.11	−0.03	−0.28	+0.11	−0.73	+2.9	+1.3
Nov.	3	Greenwich	γ Capricor.	EB	+0.73	+0.65	−0.69	+0.24	−0.73	−0.14	−0.31	+0.45	+0.66	−9.0	−8.0
	3	Greenwich	δ Capricor.	I	−0.89	−0.79	−0.53	−0.17	+0.56	+0.05	+0.37	−0.33	−0.82	+2.7	+1.1
1803, Mar.	3	Greenwich	κ Geminor.	I	−0.88	+0.32	+0.25	+0.22	+0.33	−0.08	−0.19	+0.34	−0.77	+3.7	+2.1
1804, July	17	Greenwich	π Scorpii	I	−0.52	+0.53	+0.34	+0.74	−0.81	+0.14	−0.12	+0.77	−0.42	+0.2	−0.7
Dec.	14	Greenwich	η Tauri	I	−1.08	−0.93	−0.17	−0.30	−0.35	−0.36	+0.16	−0.22	−0.40	−0.2	−2.1
	14	Greenwich	27 Tauri	I	−1.15	−0.99	−0.03	−0.05	−0.05	−0.23	+0.16	−0.22	−0.40	−0.8	−2.9
	14	Greenwich	28 Tauri	I	−1.07	−0.92	−0.18	−0.31	−0.36	−0.25	+0.16	+0.04	−0.38	−0.1	−2.0
1805, Aug.	6	Greenwich	λ Sagittarii	I	−0.87	+0.97	−0.25	−0.05	+0.25	+0.04	+0.12	−0.17	−0.65	+1.6	0.0
Sept.	[illegible]	Greenwich	θ Aquarii	I	−0.94	+0.52	−0.11	+0.12	+0.16	+0.01	+0.40	−0.05	−0.20	−2.0	−3.7
	7	Greenwich	θ Aquarii	EB	+0.90	−0.50	−0.23	+0.25	+0.34	+0.19	−3.36	−0.39	+0.18	−3.0	−1.7
1807, Dec.	14	Greenwich	ζ Tauri	IB	−0.66	+0.14	−0.69	+0.29	−0.74	−0.03	−0.01	−0.69	+0.02	−0.6	−1.8
	14	Greenwich	ζ Tauri	E	+0.88	−0.19	−0.41	+0.17	−0.44	+0.07	+0.03	−0.51	−0.06	−3.1	−1.9
1808, Apr.	5	Havana	60 Cancri	I	−0.97	−0.42	−0.08	+0.36	−0.37	−0.02	−0.29	−0.20	−0.77	−0.2	−1.9
May	3	Havana	ω Leonis	I	−0.43	−0.24	−0.04	+0.91	−0.91	+0.21	−0.17	−0.57	−0.40	+6.9	+6.1
Oct.	31	Greenwich	δ Piscium	I	−0.97	−0.69	−0.12	−0.26	−0.49	−0.12	+0.24	−0.06	−0.43	+2.5	+1.1
1809, Feb.	27	Greenwich	60 Cancri	I	−0.92	+0.21	+0.02	+0.34	−0.34	+0.05	−0.25	−0.28	[illegible]	[illegible]	−1.4
Apr.	3	Greenwich	γ Scorpii	IB	−1.10	−0.99	+0.13	−0.07	−0.15	−0.16	−0.12	+0.19	[illegible]	[illegible]	−8.3
	29	Havana	8 Libræ	IB	−1.09	−0.88	−0.31	−0.05	−0.31	−0.14	−0.20	+0.27	[illegible]	[illegible]	−2.7
	29	Havana	α Libræ	IB	−1.12	−0.91	+0.21	−0.03	−0.22	−0.16	−0.19	+0.21	[illegible]	[illegible]	−4.3
	29	Havana	α Libræ	E	+1.00	+0.82	+0.48	−0.08	−0.49	+0.27	+0.18	+0.28	[illegible]	[illegible]	−2.6
June	23	Havana	8 Libræ	I	−1.10	−0.90	−0.12	+0.02	+0.12	−0.19	−0.21	−0.02	[illegible]	[illegible]	−1.1
	23	Havana	α Libræ	I	−0.88	−0.89	−0.21	+0.04	+0.21	−0.01	−0.20	−0.08	−6.69	[illegible]	+0.5
	28	Havana	β Capricor.	IB	−1.11	−0.70	0.00	−0.13	−0.13	−0.22	+0.20	+0.13	+0.32	−0.5	−2.6
	28	Havana	β Capricor.	E	+1.08	+0.69	+0.01	+0.26	+0.26	+0.24	−0.19	−0.26	−0.31	−3.3	−1.7
Sept.	28	Greenwich	64 Tauri	E	+0.90	−0.95	−0.07	+0.07	−0.09	+0.04	−0.11	−0.11	−0.84	+0.8	+2.1
Nov.	12	Havana	β Capricor.	I	−1.08	−0.87	0.00	−0.03	−0.03	−0.17	+0.19	+0.06	−0.91	+1.3	−0.8
	12	Havana	β Capricor.	EB	+1.02	+0.83	+0.05	+0.30	+0.31	+0.19	−0.17	−0.29	+0.86	−1.7	−0.2
Dec.	15	Greenwich	ζ Piscium	I	−0.79	+0.14	+0.54	−0.03	+0.55	+0.16	+0.27	+0.18	−0.80	−0.8	−2.3
1810, Jan.	15	Greenwich	δ Tauri	I	−0.77	+0.72	−0.36	+0.37	−0.52	−0.02	+0.08	−0.43	−0.68	+2.3	+0.8
	15	Paris	δ Tauri	I	−0.82	+0.76	−0.29	+0.30	−0.42	−0.01	+0.10	−0.35	−0.72	+2.0	+0.4
	15	Paris	64 Tauri	I	−0.90	+0.84	0.00	0.00	0.00	+0.03	+0.11	+0.03	−0.79	+2.7	+1.0
	15	Greenwich	64 Tauri	I	−0.90	+0.84	−0.06	+0.06	−0.09	+0.02	+0.10	−0.05	−0.79	+1.6	−0.1
Feb.	18	Havana	π Leonis	IB	−0.93	+0.61	+0.08	+0.10	−0.13	+0.04	−0.26	−0.06	0.00	−0.3	−2.1
May	10	Paris	60 Cancri	I	−0.73	+0.72	−0.27	−0.52	+0.58	−0.09	−0.15	+0.47	−0.81	+2.5	+1.1
June	15	Paris	χ Ophiuchi	I	−0.97	−0.65	+0.29	−0.41	−0.50	−0.11	−0.11	[illegible]	[illegible]	+0.5	−1.3
July	25	Paris	63 Tauri	IB	−0.65	+0.38	−0.41	−0.58	−0.71	−0.07	+0.08	[illegible]	+0.63	−2.0	−3.2
	25	Paris	63 Tauri	E	+0.76	−0.44	−0.32	+0.46	−0.57	−0.08	−0.12	[illegible]	[illegible]	+0.2	+1.4
Sept.	18	Paris	α Tauri	IB	−0.91	+0.46	+0.15	−0.26	+0.30	0.00	+0.10	+0.29	[illegible]	[illegible]	−2.7
	18	Paris	α Tauri	E	+0.85	−0.43	+0.22	−0.39	+0.43	−0.07	−0.10	+0.41	−0.80	+0.8	+2.1
1811, Mar.	1	Paris	275 B. Tauri	I	−0.80	+0.14	+0.19	−0.52	+0.55	+0.05	+0.11	+0.51	−0.83	+2.6	+1.1
	1	Paris	α Tauri	I	−0.96	+0.17	+0.02	−0.07	+0.07	−0.03	+0.12	+0.07	−1.00	+1.9	+0.1
	1	Greenwich	α Tauri	I	−0.96	+0.17	−0.02	+0.07	−0.07	−0.05	+0.12	−0.06	−1.00	+2.3	+0.5
	1	Camb., Eng.	α Tauri	I	−0.96	+0.17	−0.04	+0.10	−0.11	−0.06	+0.12	−0.10	−0.99	+2.6	+0.8

GROUP VIII—1801-1820—Continued.

Date.		Place	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
														″	″
1811, Mar.	1	Camb., Eng.	α Tauri	EB	+0.95	−0.17	−0.05	+0.15	−0.16	+0.02	−0.12	−0.15	+0.99	−2.5	−1.1
	1	Paris	α Tauri	EB	+0.96	−0.17	0.00	0.00	0.00	+0.04	−0.11	0.00	+1.00	−2.8	−1.4
	1	Greenwich	α Tauri	EB	+0.96	−0.17	−0.04	+0.11	−0.12	+0.03	−0.12	−0.11	+0.99	−4.3	−2.9
	7	Paris	o Leonis	I	−0.56	+0.62	−0.70	−0.34	+0.78	−0.16	−0.12	+0.48	−0.24	+1.0	−0.1
July	15	Havana	α Tauri	IB	−0.73	−0.05	+0.16	−0.65	+0.67	+0.04	+0.11	+0.61	+0.58	−0.3	−1.7
	26	Havana	θ Virginis	I	−0.90	+0.70	−0.12	+0.06	+0.14	0.00	−0.28	−0.07	−0.99	+0.9	−0.8
Aug.	26	Paris	49 Libræ	I	−0.84	+0.04	−0.16	+0.47	+0.50	−0.12	−0.14	−0.44	−0.86	+1.6	0.0
Sept.	2	Paris	λ Aquarii	I	−0.68	−0.59	+0.80	+0.12	+0.81	+0.11	+0.21	−0.31	−0.03	−3.3	−4.6
	2	Paris	λ Aquarii	EB	+0.56	+0.49	+0.86	+0.13	+0.88	+0.35	−0.11	−0.30	+0.02	−1.7	−0.9
	2	Paris	78 Aquarii	I	−1.14	−0.99	+0.15	+0.02	+0.15	−0.16	+0.28	−0.08	−0.05	+2.1	−0.1
	2	Paris	78 Aquarii	EB	+1.09	+0.95	+0.32	+0.04	+0.32	+0.29	−0.26	−0.08	−0.05	−2.0	−0.4
Oct.	23	Paris	187 B. Sagittarii	I	−1.05	−0.53	−0.09	−0.16	−0.15	−0.13	+0.06	+0.12	−0.95	+6.3	+4.3
	23	Havana	45 Sagittarii	I	−0.87	−0.45	+0.29	+0.45	+0.54	−0.05	+0.08	−0.53	−0.82	+2.0	+0.3
	27	Camb., Eng.	λ Aquarii	I	−0.92	−0.91	+0.39	+0.04	+0.39	+0.07	+0.28	−0.17	−0.72	−4.2	−5.9
1812, Jan.	23	Paris	α Tauri	I	−0.30	−0.12	−0.05	+0.95	−0.95	−0.17	+0.03	−0.90	−0.24	−2.2	−2.8
	23	Paris	α Tauri	EB	+0.47	+0.19	−0.04	+0.89	−0.89	−0.08	−0.08	−0.82	+0.37	−3.1	−2.4
May	24	Havana	ν Libræ	I	−0.84	+0.61	+0.08	−0.44	−0.44	+0.08	−0.21	+0.32	−0.08	+5.6	+4.0
Aug.	28	Havana	α Tauri	IB	−0.81	−0.60	+0.08	+0.63	−0.63	−0.20	+0.13	−0.62	+0.78	+0.7	−0.8
	28	Havana	α Tauri	E	+0.99	+0.72	+0.05	+0.35	−0.35	+0.08	−0.17	−0.29	−0.93	−1.7	−0.2
Oct.	19	Havana	ν Piscium	I	−1.10	−0.95	−0.18	+0.28	−0.33	−0.32	+0.29	−0.19	+0.08	+0.2	−1.9
	19	Paris	ν Piscium	I	−1.16	−1.00	0.00	0.00	0.00	−0.21	+0.31	−0.06	−0.08	−0.1	−2.3
	21	Paris	f Tauri	E	+0.90	+0.73	+0.05	−0.62	+0.63	+0.31	−0.16	+0.50	−0.20	−0.1	+1.2
	21	Dorpat	f Tauri	IB	−1.00	−0.81	+0.04	−0.49	+0.49	−0.09	+0.22	+0.34	+0.24	−4.7	−6.6
	21	Dorpat	f Tauri	E	+0.90	+0.73	+0.05	−0.63	+0.63	+0.31	−0.16	+0.52	−0.22	−1.0	+0.4
Nov.	24	Havana	α Leonis	IB	−0.22	+0.08	+0.97	−0.04	+0.97	+0.22	−0.08	−0.52	+0.22	−1.0	−1.4
	24	Havana	α Leonis	E	+0.37	−0.13	+0.92	−0.04	+0.92	+0.21	+0.07	−0.47	−0.38	−0.1	+0.5
Dec.	10	Havana	85 Aquarii	I	−0.92	−0.64	−0.43	+0.15	−0.45	−0.21	+0.25	+0.08	−0.89	+4.7	+3.0
	10	Havana	87 Aquarii	I	−0.80	−0.55	−0.60	+0.22	−0.64	−0.26	+0.20	+0.15	−0.77	+5.3	+3.8
	14	Greenwich	μ Ceti	I	−0.85	−0.95	+0.06	−0.28	+0.29	+0.11	+0.29	+0.12	−0.65	+4.6	+3.0
	16	Dorpat	γ Tauri	I	−1.00	−0.77	+0.08	+0.46	−0.46	−0.26	+0.25	−0.46	−0.34	−0.9	−2.8
	16	Dorpat	γ Tauri	EB	+1.06	+0.82	+0.06	+0.28	−0.34	+0.13	−0.18	−0.26	+0.37	−9.9	−8.3
	16	Dorpat	θ² Tauri	I	−0.82	+0.64	−0.15	−0.67	+0.68	+0.02	+0.14	+0.64	−0.29	−1.8	−3.4
	16	Dorpat	264 B. Tauri	I	−1.13	−0.87	+0.01	+0.05	−0.05	−0.20	+0.19	−0.10	−0.39	+2.5	+0.4
	16	Dorpat	α Tauri	I	−1.11	−0.88	+0.03	+0.16	−0.16	−0.23	+0.17	−0.19	−0.39	−0.3	−2.5
1813, Mar.	6	Greenwich	μ Ceti	I	−1.04	−0.93	−0.05	+0.35	−0.35	−0.28	+0.26	−0.30	−0.74	+0.1	−1.9
	6	Paris	μ Ceti	I	−1.08	−0.97	−0.03	+0.22	−0.22	−0.24	+0.27	−0.21	−0.87	+0.2	−1.9
	6	Camb., Eng.	μ Ceti	I	−1.02	−0.92	−0.06	+0.39	−0.40	−0.28	+0.25	−0.31	−0.73	+2.4	+0.5
	8	Camb., Eng.	α Tauri	I	−1.04	−0.90	+0.08	+0.25	−0.26	−0.16	+0.07	−0.19	−0.95	+2.5	+0.5
Apr.	8	Dorpat	ζ Cancri	I	−1.00	−0.41	+0.05	+0.02	−0.05	−0.06	−0.10	−0.10	−1.00	+5.1	+3.2
	8	Dorpat	ζ Cancri	I	−1.00	−0.41	+0.05	+0.02	−0.05	−0.06	−0.10	−0.10	−1.00	+6.8	+4.9
	8	Dorpat	ζ Cancri	EB	+1.00	+0.40	+0.17	+0.05	−0.18	+0.10	+0.11	−0.10	+0.98	−0.8	+0.7
	10	Dorpat	ν Leonis	I	−0.95	+0.04	+0.13	−0.02	−0.13	+0.01	−0.24	−0.12	−0.83	+3.5	+1.7
	10	Dorpat	ν Leonis	EB	+0.93	−0.04	+0.25	−0.04	−0.25	+0.08	+0.23	−0.09	+0.81	−8.8	−7.4
	17	Greenwich	γ Libræ	IB	−0.89	+0.97	−0.02	−0.17	−0.17	+0.06	−0.26	+0.08	+0.40	−0.1	−1.8
	17	Greenwich	γ Libræ	E	+0.82	−0.90	−0.04	−0.42	−0.42	+0.08	+0.21	+0.38	−0.37	−2.2	−1.0
July	11	Camb., Eng.	μ Sagittarii	I	−0.79	+0.68	+0.39	+0.34	+0.52	−0.04	−0.04	−0.57	−0.24	+1.0	−0.5
	12	Paris	π Sagittarii	I	−0.90	+0.58	+0.26	+0.14	+0.30	0.00	+0.01	−0.37	−0.06	+3.6	+1.9
Aug.	13	Greenwich	ψ¹ Aquarii	E	+0.56	+0.18	+0.70	−0.47	+0.84	−0.26	−0.13	−0.19	−0.23	−2.2	−1.4
Sept.	14	Greenwich	27 Tauri	F	+1.01	+0.89	−0.09	−0.39	+0.40	+0.26	−0.23	+0.31	−0.76	−0.9	+0.6
Nov.	29	Camb., Eng.	δ Capricor.	I	−0.75	+0.17	+0.59	−0.18	+0.61	+0.12	+0.20	−0.45	−0.79	+3.0	+1.6
Dec.	28	Paris	ψ¹ Aquarii	I	−0.83	−0.08	−0.39	+0.35	−0.53	−0.20	+0.24	−0.06	−0.81	+3.1	+1.5
1814, Jan.	1	Camb., Eng.	μ Ceti	I	−0.75	−0.61	+0.09	+0.72	−0.72	−0.35	+0.19	−0.52	−0.59	+3.6	+2.2
	28	Camb., Eng.	ξ² Ceti	I	−1.02	−0.77	−0.02	−0.25	+0.26	−0.05	+0.33	+0.07	−0.97	+5.7	+3.8
Feb.	1	Camb., Eng.	ν Geminor.	I	−0.98	−0.84	−0.42	−0.21	+0.47	−0.15	+0.03	+0.36	−0.53	+4.5	+2.6
	1	Dorpat	ν Geminor.	I	−1.11	−0.96	+0.04	+0.02	−0.04	−0.19	+0.04	−0.14	−0.61	+3.2	+1.1
Oct.	1	Greenwich	μ Ceti	IB	−1.00	−0.43	−0.11	−0.29	+0.31	−0.04	+0.35	+0.10	+0.51	+1.3	−0.6
	1	Paris	μ Ceti	IB	−0.95	−0.41	−0.15	−0.38	+0.41	+0.01	+0.34	+0.17	+0.48	−1.6	−3.4
	1	Paris	μ Ceti	E	+0.82	+0.35	−0.23	−0.58	+0.63	+0.32	−0.23	+0.48	−0.40	−1.8	−0.6
	1	Camb., Eng.	μ Ceti	IB	−1.00	−0.43	−0.10	−0.27	+0.29	−0.04	+0.34	+0.09	−0.51	−2.6	−4.5
	1	Greenwich	μ Ceti	E	+0.90	+0.39	−0.19	−0.48	+0.52	+0.30	−0.26	+0.42	−0.45	−1.5	−0.2
1816, Apr.	12	Dorpat	κ Virginis	IB	−1.09	−0.75	−0.18	−0.19	−0.26	−0.12	−0.38	+0.16	+0.14	0.0	−2.1
1817, Dec.	30	Paris	γ Virginis	IB	−1.03	−0.68	−0.08	−0.01	−0.10	−0.09	−0.46	−0.04	+0.97	+1.6	−0.4
1818, Feb.	13	Paris	A Tauri	I	−0.89	+1.00	+0.08	−0.03	−0.08	−0.02	+0.27	−0.14	−0.97	+2.1	+0.4
	13	Paris	39 Tauri	I	−0.82	+0.90	−0.39	+0.13	+0.42	+0.10	+0.26	+0.31	−0.88	+3.9	+2.3
1819, Sept.	8	Dorpat	ζ Arietis	IB	−0.80	+0.08	+0.46	−0.35	−0.58	−0.26	+0.25	−0.47	+0.67	−0.4	−1.9
Oct.	9	Dorpat	49 Aurigæ	IB	−0.92	+0.78	0.00	0.00	0.00	0.00	−0.02	−0.03	+0.95	−1.7	−3.4
1820, Feb.	1	Camb., Eng.	χ Leonis	IB	−0.81	+0.84	+0.40	+0.17	+0.43	−0.20	−0.35	+0.32	+0.47	−6.1	−7.6
	1	Camb., Eng.	χ Leonis	E	+0.86	−0.89	+0.26	+0.11	+0.29	−0.13	+0.46	+0.13	−0.50	−0.7	+0.6
Apr.	23	Dorpat	χ Leonis	I	−0.36	+0.41	−0.86	−0.29	−0.91	+0.40	−0.29	−0.55	−0.32	−1.0	−1.7
Aug.	28	Dorpat	47 Arietis	IB	−0.83	−0.56	+0.27	−0.34	−0.44	−0.16	+0.27	−0.32	+0.78	−4.3	−5.9
	28	Dorpat	47 Arietis	E	+1.03	+0.61	+0.11	−0.15	−0.19	+0.09	−0.33	−0.14	−0.85	+0.4	+1.9

GROUP IX—1821–1838.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1821, Feb. 6	Paris	62 Piscium	I	−1.07	−0.98	−0.18	+0.09	+0.20	−0.11	+0.49	+0.06	−0.77	−1.6	−3.6
6	Camb., Eng.	δ Piscium	I	−0.82	−0.74	+0.59	−0.30	−0.67	−0.46	+0.26	−0.12	−0.58	+1.8	+0.2
6	Paris	δ Piscium	I	−0.98	−0.89	+0.41	−0.21	−0.46	−0.41	+0.47	−0.08	−0.70	+0.6	−1.3
6	Dorpat	62 Piscium	I	−1.10	−1.00	+0.06	−0.03	−0.07	−0.25	+0.46	0.00	−0.79	−0.7	−2.8
6	Dorpat	δ Piscium	I	−0.65	−0.59	+0.72	−0.37	−0.81	−0.49	+0.18	−0.16	−0.47	+0.6	−0.6
6	Dorpat	δ Piscium	EB	+0.75	+0.68	−0.65	+0.34	+0.73	+0.49	−0.24	+0.15	+0.54	+1.7	+2.8
12	Paris	49 Aurigæ	I	−0.91	−0.09	+0.12	+0.34	+0.36	−0.07	−0.06	+0.38	−0.69	+0.3	−1.4
May 6	Dorpat	κ Geminor.	I	−0.98	+0.01	−0.01	−0.02	−0.02	−0.07	−0.19	−0.08	−0.86	+2.1	+0.2
6	Camb., Eng	κ Geminor.	I	−0.88	+0.05	+0.31	+0.24	+0.48	−0.16	−0.17	+0.47	−0.76	+0.6	−1.1
July 22	Dorpat	μ Arietis	IB	−0.83	−0.74	+0.27	−0.58	−0.64	−0.33	+0.22	−0.54	+0.76	−1.2	−2.8
23	Dorpat	16 Tauri	IB	−1.07	−0.86	+0.01	−0.07	−0.08	−0.18	+0.24	−0.04	+0.92	−2.5	−4.5
23	Dorpat	17 Tauri	IB	−0.87	−0.70	−0.10	+0.57	+0.58	0.00	+0.22	+0.51	+0.75	−3.4	−5.1
23	Dorpat	q Tauri	IB	−0.88	−0.71	+0.10	−0.56	−0.57	−0.24	+0.17	−0.45	+0.76	+0.7	−1.0
23	Dorpat	20 Tauri	IB	−1.07	−0.86	+0.01	−0.06	−0.06	−0.17	+0.23	−0.04	+0.92	−0.4	−2.4
23	Dorpat	21 Tauri	IB	−0.80	−0.65	+0.11	−0.65	−0.66	−0.25	+0.15	−0.54	+0.70	+0.8	−0.7
23	Dorpat	17 Tauri	E	+0.72	+0.58	−0.12	+0.73	+0.74	+0.28	−0.14	+0.60	−0.62	−0.2	+0.9
23	Paris	q Tauri	IB	−0.60	−0.55	+0.13	−0.75	−0.76	−0.27	+0.12	−0.63	+0.58	−3.6	−4.9
23	Paris	20 Tauri	IB	−1.03	−0.83	+0.05	−0.27	−0.27	−0.20	+0.21	−0.22	+0.80	−5.1	−7.1
23	Paris	22 Tauri	IB	−0.71	−0.57	+0.12	−0.73	−0.74	−0.27	+0.14	−0.61	+0.62	−3.8	−5.1
23	Paris	21 Tauri	IB	−0.54	−0.43	+0.14	−0.85	−0.86	−0.24	+0.08	−0.71	+0.46	+0.5	−0.5
23	Paris	21 Tauri	E	+0.73	+0.56	+0.11	−0.72	−0.73	−0.20	−0.23	−0.64	−0.63	−1.0	+0.1
23	Paris	16 Tauri	E	+1.06	+0.84	+0.01	−0.08	−0.08	+0.16	−0.23	−0.10	−0.93	−3.1	−1.5
23	Paris	Anon. 4	E	+1.06	+0.85	0.00	0.00	0.00	+0.17	−0.21	−0.04	−0.93	+1.9	+3.5
23	Paris	20 Tauri	E	+1.06	+0.84	0.00	−0.06	−0.06	+0.16	−0.23	−0.08	−0.93	+1.0	+2.6
23	Dorpat	16 Tauri	E	+1.06	+0.85	−0.02	+0.14	+0.14	+0.19	−0.22	+0.09	−0.91	−0.5	+1.1
23	Dorpat	20 Tauri	E	+1.05	+0.84	−0.03	+0.17	+0.17	+0.19	−0.22	+0.12	−0.90	−3.8	−2.2
Sept. 10	Paris	σ Aquarii	I	−0.94	−0.54	−0.52	−0.01	+0.52	+0.04	+0.44	−0.22	−0.18	+0.6	−1.2
Oct. 13	Camb., Eng.	17 Tauri	IB	−1.00	−0.83	−0.05	+0.47	+0.47	−0.09	+0.21	+0.42	+0.43	−5.8	−7.7
13	Camb., Eng.	q Tauri	IB	−0.89	−0.74	+0.06	−0.62	−0.62	−0.30	+0.16	−0.50	+0.40	−1.8	−3.5
13	Camb., Eng.	20 Tauri	IB	−1.12	−0.93	+0.01	−0.13	−0.13	−0.24	+0.22	−0.09	+0.50	−2.2	−4.3
13	Paris	17 Tauri	IB	−0.91	−0.75	−0.06	+0.59	+0.60	−0.05	+0.19	+0.53	+0.42	−5.5	−7.2
13	Paris	q Tauri	IB	−0.98	−0.82	+0.05	−0.50	−0.51	−0.29	+0.18	−0.40	+0.45	−2.7	−4.6
13	Paris	20 Tauri	IB	−1.13	−0.82	0.00	−0.01	−0.01	−0.25	+0.23	+0.04	+0.49	−2.3	−4.4
13	Paris	21 Tauri	IB	−0.92	−0.77	+0.05	−0.58	−0.58	−0.29	+0.17	−0.47	+0.43	−5.7	−7.4
13	Paris	17 Tauri	E	+0.69	+0.56	−0.07	+0.79	+0.80	+0.17	−0.11	+0.65	−0.30	−0.3	+0.7
13	Paris	16 Tauri	E	+1.10	+0.91	−0.02	+0.23	+0.24	+0.25	−0.20	+0.16	−0.51	−2.0	−0.4
13	Paris	q Tauri	E	+1.10	+0.91	+0.02	−0.24	−0.24	+0.16	−0.22	−0.23	−0.51	+1.5	+3.1
13	Paris	Anon. 4	E	+1.07	+0.89	−0.03	+0.33	+0.33	+0.27	+0.20	+0.25	−0.50	+0.7	+2.3
13	Paris	20 Tauri	E	+1.09	+0.90	−0.02	+0.28	+0.28	+0.26	−0.20	+0.21	−0.51	+1.4	+3.0
13	Paris	21 Tauri	E	+1.08	+0.89	+0.03	−0.32	−0.32	+0.15	−0.22	−0.30	−0.50	+0.7	+2.3
13	Camb., Eng.	17 Tauri	E	+0.83	+0.69	−0.06	+0.68	+0.68	+0.29	−0.14	+0.54	−0.35	−0.8	+0.4
13	Camb., Eng.	16 Tauri	E	+1.13	+0.93	−0.01	+0.10	+0.10	+0.24	−0.20	+0.05	−0.50	+1.2	+2.9
15	Camb., Eng.	136 Tauri	IB	−0.75	−0.49	−0.28	−0.65	−0.71	+0.10	0.00	−0.67	+0.58	−4.8	−6.2
15	Camb., Eng.	136 Tauri	E	+0.91	+0.59	−0.21	−0.49	−0.53	+0.13	0.00	−0.57	−0.70	−0.3	+1.1
Dec. 7	Dorpat	q Tauri	I	−1.12	−0.93	+0.01	−0.20	−0.20	−0.18	−0.14	−0.14	−0.34	−0.1	−2.2
7	Dorpat	17 Tauri	I	−0.21	−0.18	−0.04	+0.98	+0.98	+0.16	+0.06	+0.83	−0.07	+0.3	−0.1
7	Dorpat	17 Tauri	EB	+0.04	+0.04	−0.03	+1.00	+1.00	+0.20	+0.02	+0.84	+0.01	−0.3	+0.2
7	Dorpat	21 Tauri	I	−1.08	−0.90	+0.01	−0.33	−0.33	−0.27	+0.19	−0.24	−0.33	−0.7	−2.8
7	Dorpat	q Tauri	EB	+1.14	+0.95	0.00	−0.07	−0.07	+0.21	−0.21	−0.10	+0.35	+0.3	+2.0
1822, Feb. 8	Paris	υ Leonis	IB	−0.09	+0.06	+0.89	−0.44	+0.99	−0.47	+0.06	+0.12	+0.06	−5.6	−5.8
8	Paris	υ Leonis	E	+0.23	−0.12	+0.86	−0.44	+0.97	−0.41	+0.20	+0.09	−0.11	+0.1	+0.4
8	Dorpat	υ Leonis	IB	−0.92	+0.52	+0.22	−0.11	+0.25	−0.18	−0.43	+0.19	+0.47	−2.5	−4.2
8	Dorpat	υ Leonis	E	+0.95	−0.54	+0.01	−0.01	+0.01	+0.06	+0.45	+0.04	−0.48	+1.2	+2.6
27	Dorpat	q Tauri	I	−0.38	−0.36	+0.05	+0.94	+0.94	+0.12	+0.08	+0.81	−0.36	−4.4	−5.1
27	Dorpat	21 Tauri	I	−0.72	+0.66	+0.04	+0.74	+0.75	+0.03	+0.14	+0.67	−0.66	+0.6	−0.8
27	Dorpat	q Tauri	EB	+0.43	+0.41	+0.03	+0.49	+0.49	+0.24	−0.07	+0.75	+0.41	−3.6	−3.0
Apr. 30	Paris	d Leonis	I	−0.88	+0.20	−0.35	+0.13	−0.37	+0.11	−0.47	−0.04	−0.83	+0.9	−0.8
May 1	Dorpat	υ Leonis	I	−0.40	+0.16	−0.78	+0.46	−0.90	+0.40	−0.31	−0.50	−0.33	+0.8	0.0
1	Dorpat	υ Leonis	EB	+0.15	−0.06	−0.84	+0.51	−0.99	+0.46	−0.04	−0.57	+0.13	−2.1	−1.9
Aug. 10	Dorpat	17 Tauri	E	+1.02	+0.93	+0.06	+0.33	+0.34	+0.22	−0.19	+0.24	−0.92	+1.3	+2.8
10	Dorpat	16 Tauri	E	+1.03	+0.94	−0.06	−0.30	−0.31	+0.10	−0.20	−0.32	−0.93	+4.9	+6.4
10	Dorpat	20 Tauri	IB	−0.95	−0.87	−0.09	−0.46	−0.47	−0.22	+0.16	−0.35	+0.86	−2.5	−4.3
10	Dorpat	q Tauri	E	+0.51	+0.46	−0.17	−0.86	−0.88	−0.08	−0.10	−0.77	−0.46	+2.7	+3.5
10	Dorpat	η Tauri	IB	−0.55	−0.52	+0.16	+0.84	+0.86	+0.08	+0.12	+0.76	+0.51	−3.2	−4.2
10	Dorpat	22 Tauri	E	+0.45	+0.40	−0.17	−0.89	−0.91	−0.09	−0.09	−0.80	−0.40	+3.7	+4.4
10	Dorpat	20 Tauri	E	+1.01	+0.92	−0.07	−0.34	−0.35	+0.09	−0.19	−0.35	−0.91	+2.5	+4.0
10	Dorpat	η Tauri	E	+0.41	+0.38	+0.18	+0.91	+0.92	+0.23	−0.05	+0.76	−0.37	+0.3	+0.9
Sept. 6	Camb., Eng.	q Tauri	IB	−1.07	−0.97	+0.03	+0.14	+0.14	−0.13	+0.19	+0.17	+0.93	−5.1	−7.1
Oct. 31	Dorpat	23 Tauri	IB	−1.14	−0.95	+0.02	+0.08	+0.08	−0.21	+0.20	+0.13	+0.28	−2.6	−4.8
31	Dorpat	η Tauri	IB	−1.13	−0.93	−0.05	−0.18	−0.18	−0.26	+0.19	−0.09	+0.27	−1.9	−4.0

GROUP IX—1821–1838—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	h_0	α_0	δ_0	ε	P	n	n'
													″	″
1822, Oct. 31	Dorpat	23 Tauri	E	+1.10	+0.91	+0.07	+0.26	−0.27	+0.26	−0.17	+0.18	−0.27	+1.3	+2.9
31	Dorpat	27 Tauri	IB	−1.05	−0.88	+0.11	+0.39	+0.41	−0.14	+0.15	+0.40	+0.26	−1.9	−3.9
31	Dorpat	η Tauri	E	+1.15	+0.95	+0.01	+0.02	+0.02	+0.26	−0.19	−0.04	−0.28	+4.4	+6.1
31	Dorpat	27 Tauri	E	+0.92	+0.77	+0.16	+0.57	+0.59	+0.28	−0.14	+0.45	−0.23	+3.0	+4.4
Nov. 30	Dorpat	ε Geminor.	IB	−1.13	−0.96	−0.11	−0.07	−0.13	−0.21	−0.14	−0.06	+0.38	−3.3	−5.4
Dec. 25	Dorpat	17 Tauri	I	−1.12	−0.93	−0.05	−0.15	−0.15	−0.24	+0.18	−0.06	−0.55	−1.5	−3.6
25	Paris	η Tauri	I	−1.07	−0.88	+0.10	+0.32	+0.34	−0.14	+0.18	+0.35	−0.53	+1.2	−0.8
25	Dorpat	16 Tauri	I	−0.76	−0.63	−0.23	−0.71	−0.74	−0.29	+0.13	−0.59	−0.38	−0.1	−1.5
25	Dorpat	20 Tauri	I	−0.73	−0.60	−0.23	−0.73	−0.76	−0.26	+0.10	−0.60	−0.36	+0.6	−0.8
25	Dorpat	η Tauri	I	−0.97	−0.81	+0.16	+0.39	+0.52	−0.10	+0.16	+0.49	−0.48	−0.8	−2.6
25	Dorpat	η Tauri	EB	+0.83	+0.69	+0.22	+0.65	+0.69	+0.28	−0.13	+0.54	+0.41	+0.4	+1.6
25	Dorpat	28 Tauri	I	−0.60	−0.50	+0.27	+0.80	+0.85	+0.03	+0.11	+0.76	−0.30	−0.8	−1.9
1823, Jan. 24	Camb., Eng.	ε Geminor.	I	−1.13	−0.97	+0.08	+0.05	+0.09	−0.24	−0.14	+0.16	−0.45	+0.8	−1.2
24	Dorpat	ε Geminor.	I	−1.13	−0.97	+0.04	+0.02	+0.04	−0.23	−0.12	+0.11	−0.45	+0.2	−1.8
24	Dorpat	ε Geminor.	EB	+1.13	+0.97	+0.05	+0.03	+0.06	+0.21	+0.12	−0.01	+0.45	+3.1	+4.6
May 18	Camb., Eng.	p^5 Leonis	I	−0.83	−0.36	+0.40	−0.40	+0.57	−0.34	−0.31	+0.22	−0.79	+1.6	+0.1
June 17	Paris	69 Virginis	I	−0.49	+0.06	+0.09	−0.86	+0.86	−0.33	−0.13	−0.31	−0.48	+0.5	−0.4
Sept. 23	Dorpat	μ Arietis	E	+1.01	+0.41	−0.06	−0.20	−0.20	+0.05	−0.28	−0.24	−0.70	+2.7	+4.1
1824, Jan. 7	Camb., Eng.	19 Piscium	I	−0.58	+0.32	+0.30	−0.72	−0.78	−0.34	+0.19	+0.10	−0.60	+0.6	−0.4
Mar. 12	Paris	o Leonis	I	−1.12	−0.97	+0.12	−0.09	+0.16	−0.29	−0.36	+0.18	−0.52	−0.5	−2.5
Sept. 4	Dorpat	ρ Capricor.	I	−0.68	+0.66	−0.58	+0.30	+0.65	+0.18	+0.25	−0.45	−0.53	−1.0	−2.2
Dec. 7	Paris	μ Geminor.	E	+1.02	+0.43	−0.24	+0.01	−0.24	+0.16	+0.10	−0.33	−0.33	−1.0	+0.4
31	Paris	ζ Arietis	I	−0.78	+0.23	+0.46	+0.38	+0.60	+0.08	+0.16	+0.20	−0.56	0.0	−1.4
1825, Jan. 3	Dorpat	1 Geminor.	I	−0.72	−0.23	−0.73	−0.08	−0.73	−0.05	−0.05	−0.67	−0.12	−1.0	−2.3
Feb. 11	Paris	θ Ophiuchi	E	+0.82	+0.08	−0.53	−0.08	+0.54	−0.03	+0.14	−0.45	−0.78	+3.0	+4.1
27	Dorpat	η Geminor.	I	−0.93	−0.31	−0.41	+0.03	−0.41	−0.06	−0.08	−0.33	−0.77	+0.2	−1.5
Mar. 24	Dorpat	A Tauri	I	−0.93	+0.24	+0.16	+0.07	+0.18	0.00	+0.10	+0.27	−0.90	+2.0	+0.3
24	Dorpat	39 Tauri	I	−0.95	+0.21	+0.42	+0.18	+0.46	−0.08	+0.09	+0.50	−0.82	+0.6	−1.1
28	Paris	g Geminor.	I	−0.63	−0.36	−0.71	+0.37	−0.80	+0.10	−0.17	−0.67	−0.54	−0.8	−1.9
Apr. 1	Camb., Eng.	c Leonis	I	−1.05	+0.91	+0.03	−0.42	+0.42	−0.41	−0.32	+0.15	−0.27	+0.2	−1.7
June 27	Paris	19 Scorpii	I	−0.41	−0.21	−0.89	−0.24	+0.92	−0.12	−0.03	−0.79	−0.24	+1.2	+0.5
July 4	Paris	κ Aquarii	IB	−0.70	+0.67	−0.15	+0.63	+0.65	+0.24	+0.33	−0.20	+0.60	−4.9	−6.2
4	Paris	κ Aquarii	E	+0.52	−0.50	−0.18	+0.80	+0.82	+0.31	−0.16	−0.36	−0.43	+0.6	+1.3
27	Dorchester	o Sagittarii	I	−0.56	+0.01	−0.76	+0.33	+0.83	+0.08	+0.11	−0.76	−0.27	+2.8	+1.8
27	Dorchester	o Sagittarii	EB	+0.62	−0.01	−0.71	+0.31	+0.78	+0.18	−0.10	−0.81	+0.31	+0.9	+1.8
27	Dorchester	π Sagittarii	I	−0.50	+0.01	+0.78	−0.37	−0.86	−0.17	+0.06	+0.88	−0.25	+3.2	+2.3
Sept. 4	Paris	67 Tauri	IB	−0.82	+0.42	−0.46	−0.09	−0.47	−0.03	+0.06	−0.35	+0.87	−6.2	−7.7
4	Paris	κ Tauri	IB	−0.56	+0.29	−0.78	−0.16	−0.80	−0.05	+0.04	−0.67	−0.96	−2.7	−3.7
4	Paris	67 Tauri	E	+0.91	−0.47	−0.22	−0.04	−0.22	−0.01	−0.07	−0.28	+0.59	+4.1	+5.4
23	Dorpat	c^2 Capricor.	I	−0.85	+0.54	+0.15	−0.36	−0.38	−0.14	+0.28	+0.29	−0.64	+2.7	+1.2
Dec. 14	Cracow	c^1 Capricor.	I	−0.76	+0.34	−0.20	+0.58	+0.62	+0.18	+0.31	−0.30	−0.62	−2.3	−3.7
1826, Jan. 13	Camb., Eng.	19 Piscium	I	−0.78	+0.71	−0.15	−0.52	−0.54	−0.19	+0.26	+0.11	−0.71	+3.2	+1.8
Feb. 15	Dorpat	53 Tauri	I	−0.84	+0.71	+0.39	+0.02	+0.40	+0.05	+0.08	+0.44	−0.89	−0.9	−2.4
16	Dorpat	105 Tauri	I	−0.93	+0.62	+0.09	−0.01	+0.09	−0.01	+0.02	+0.21	−0.90	−0.5	−2.2
May 12	Berlin	1 Cancri	I	−0.65	+0.06	−0.45	+0.59	−0.74	+0.13	−0.18	−0.60	−0.64	−1.1	−2.2
13	Berlin	A^2 Cancri	I	−0.98	−0.14	0.00	0.00	0.00	−0.07	−0.28	+0.09	−1.00	−2.0	−3.7
July 27	Berlin	53 Arietis	IB	−0.76	+0.02	+0.52	+0.12	+0.53	+0.12	+0.15	+0.44	+0.83	−5.8	−7.1
Sept. 13	Paris	c^1 Capricor.	I	−0.91	−0.06	−0.03	+0.40	+0.41	+0.05	+0.30	−0.34	−0.51	+0.6	−1.0
21	Berlin	43 Tauri	E	+0.78	−0.86	−0.48	−0.04	+0.48	+0.01	−0.09	+0.37	−0.78	−0.3	+0.8
Oct. 24	Paris	κ Cancri	E	+0.96	−0.10	−0.04	+0.18	−0.19	+0.12	+0.28	−0.09	−0.92	+2.0	+3.3
1827, Jan. 5	Paris	π Piscium	I	−0.86	+0.67	+0.31	+0.15	+0.34	+0.12	+0.29	+0.20	−0.93	+0.5	−1.0
14	Greenwich	κ Cancri	IB	−0.89	+0.29	+0.05	−0.37	+0.38	−0.15	−0.26	+0.33	+0.34	−2.5	−4.0
14	Greenwich	κ Cancri	E	+0.90	−0.29	+0.04	−0.35	+0.35	−0.05	+0.29	+0.19	−0.34	+3.6	+4.8
19	Greenwich	i Virginis	E	+0.59	+0.44	−0.73	−0.39	+0.82	−0.18	+0.19	−0.36	−0.56	+1.9	+2.7
Feb. 10	Dorchester	α Cancri	I	−0.54	+0.23	−0.12	+0.82	−0.83	+0.07	−0.06	−0.68	−0.45	−5.0	−5.9
10	Paris	60 Cancri	I	−0.96	+0.40	−0.02	+0.15	−0.15	+0.01	−0.28	−0.05	−0.08	−1.7	−3.3
July 2	Paris	49 Virginis	I	−0.77	−0.38	−0.60	−0.27	+0.65	−0.25	−0.19	−0.14	−0.72	+0.2	−1.1
2	Cracow	49 Virginis	I	−0.85	−0.42	−0.52	−0.23	+0.57	−0.24	+0.09	−0.10	−0.46	−4.3	−5.7
Aug. 1	Cracow	41 Libræ	I	−0.92	−0.77	−0.49	+0.13	+0.51	−0.18	−0.19	−0.36	−0.85	+1.9	+0.3
29	Cracow	58 G. Scorpii	I	−0.82	−0.71	−0.61	−0.17	+0.63	−0.14	−0.07	−0.53	−0.76	−0.9	−2.3
Nov. 16	Dorchester	α Virginis	IB	−1.01	−0.30	+0.27	+0.06	−0.28	−0.02	−0.30	+0.17	+0.46	+3.2	+1.5
28	Dorchester	ε Piscium	I	−0.97	−0.05	+0.03	+0.01	+0.03	0.00	+0.30	+0.05	−0.86	+5.0	+3.4
Dec. 8	Greenwich	ω Leonis	IB	−0.91	+0.75	−0.01	+0.05	+0.05	0.00	−0.28	+0.08	+0.91	−2.6	−4.1
8	Greenwich	ω Leonis	E	+0.89	−0.74	−0.06	−0.19	+0.20	+0.04	+0.26	−0.17	−0.90	−2.3	−1.1
8	Camb., Eng.	ω Leonis	E	+0.89	−0.73	+0.06	+0.22	−0.22	+0.05	+0.26	−0.20	−0.88	−1.1	+0.1
1828, Feb. 22	Cracow	68 Tauri	I	−0.85	+0.60	+0.30	−0.23	+0.39	+0.06	+0.11	+0.37	−0.92	−3.1	−4.5
Mar. 23	Greenwich	26 Geminor.	I	−0.87	+0.91	+0.09	−0.26	−0.28	+0.03	−0.09	−0.24	−0.95	−1.6	−3.1
24	Greenwich	68 Geminor.	I	−0.89	+0.99	+0.01	−0.11	+0.11	+0.01	−0.15	+0.09	−0.94	+0.6	−0.9
24	Berlin	68 Geminor.	IB	−0.89	+0.99	−0.05	−0.14	−0.15	+0.04	−0.16	−0.09	+0.24	+0.7	−0.8
24	Berlin	67 Geminor.	IB	−0.71	+0.79	+0.21	+0.58	+0.61	−0.09	−0.12	+0.63	+0.19	−2.4	−3.6

GROUP IX—1821–1838—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	∂_0	ε	P	n	n'
													″	″
1828, June 16	Cracow	κ Cancri	I	−0.90	+0.98	−0.02	−0.05	+0.06	+0.03	−0.36	−0.05	−0.76	+1.2	−0.3
Aug. 16	Dorchester	λ Virginis	I	−0.85	−0.02	−0.46	+0.12	+0.48	−0.13	−0.19	−0.22	−0.86	+7.2	+5.8
1829, Jan. 18	Camb., Eng.	λ Geminor.	I	−0.75	+0.58	−0.04	−0.58	+0.58	−0.04	−0.07	+0.57	−0.23	+1.6	+0.4
Apr. 12	Cracow	α Cancri	I	−0.66	+0.63	−0.38	−0.57	+0.69	−0.11	−0.23	+0.54	−0.77	−0.2	−1.3
June 13	Cracow	μ Libræ	I	−0.80	+0.37	−0.44	+0.35	+0.57	−0.15	−0.17	−0.44	−0.47	+0.5	−0.8
13	Paris	μ Libræ	I	−0.72	+0.33	−0.59	+0.46	+0.74	−0.15	−0.15	−0.41	−0.44	+0.9	−0.2
Aug. 21	Paris	70 Tauri	E	+0.76	+0.29	+0.28	−0.59	+0.66	+0.14	−0.09	+0.60	−0.75	−3.1	−2.2
21	Dorchester	α Tauri	IB	−0.92	−0.34	+0.17	+0.38	−0.42	−0.13	+0.11	−0.39	+0.91	+5.1	+3.7
21	Dorchester	α Tauri	E	+0.98	+0.36	−0.09	+0.22	−0.24	+0.06	−0.12	−0.23	−0.97	−5.9	−4.8
21	Paris	α Tauri	IB	−0.94	−0.34	+0.14	−0.33	+0.36	−0.04	+0.12	+0.33	+0.93	+3.3	+1.9
Sept. 17	Dorchester	α Tauri	IB	−1.00	+0.37	+0.09	−0.23	+0.25	−0.05	+0.12	+0.22	+0.75	−0.8	−2.3
23	Dorchester	ο Leonis	IB	−0.52	+0.44	+0.65	−0.50	+0.83	−0.17	−0.11	+0.50	+0.41	−1.2	−2.0
23	Dorchester	ο Leonis	E	+0.56	−0.39	+0.70	+0.53	+0.87	−0.11	+0.15	+0.54	−0.36	−8.3	−7.7
Oct. 15	Paris	α Tauri	IB	−0.75	−0.33	−0.25	+0.67	−0.71	−0.19	+0.09	−0.66	+0.41	+0.4	−0.7
15	Camb., Eng.	α Tauri	IB	−0.60	−0.26	−0.29	+0.77	−0.83	−0.18	+0.06	−0.77	+0.32	+1.2	+0.3
15	Camb., Eng.	α Tauri	E	+0.74	+0.33	−0.24	+0.68	−0.72	+0.01	−0.09	−0.67	−0.40	0 0	+0.8
15	Paris	α Tauri	E	+0.88	+0.39	−0.20	+0.54	−0.57	+0.06	−0.10	−0.54	−0.48	−0.4	+0.4
Nov. 11	Dorchester	α Tauri	IB	−0.63	−0.27	−0.25	−0.78	+0.81	0.00	+0.09	+0.75	+0.11	−0.6	−1.6
11	Dorchester	α Tauri	E	+0.76	+0.33	+0.21	−0.68	+0.71	+0.20	−0.08	+0.66	−0.14	−1.4	−0.6
Dec. 9	Cracow	α Tauri	I	−1.08	−0.53	−0.03	+0.05	−0.05	−0.13	+0.06	−0.05	−0.27	+2.2	+0.6
1830, Jan. 5	Dorchester	α Tauri	I	−0.77	−0.41	+8.18	−0.66	+0.68	−0.02	+0.09	+0.64	−0.49	+0.4	−0.8
5	Greenwich	α Tauri	I	−1.02	−0.54	−0.06	−0.23	−0.24	−0.16	+0.13	−0.24	−0.65	−4.4	−5.9
Mar. 2	Cracow	130 Tauri	I	−0.86	−0.35	+0.05	+0.53	−0.54	−0.10	−0.05	−0.54	−0.78	+0.7	−0.6
3	Cracow	26 Geminor.	I	−0.84	−0.17	+0.16	+0.50	−0.53	−0.06	−0.12	−0.52	−0.74	+0.4	−0.9
3	Berlin	26 Geminor.	I	−0.80	−0.17	+0.18	+0.56	−0.58	−0.04	−0.03	−0.60	−0.76	−0.2	−1.4
28	Camb., Eng.	θ^1 Tauri	I	−1.04	−0.68	+0.06	−0.27	+0.28	−0.12	+0.16	+0.22	−0.79	+2.4	+0.8
28	Camb., Eng.	θ^2 Tauri	I	−0.85	−0.55	+0.14	−0.63	+0.65	+0.22	−0.12	+0.60	+0.64	−2.0	−3.3
28	Greenwich	θ^1 Tauri	I	−1.03	−0.67	+0.07	−0.31	+0.32	−0.12	+0.14	+0.26	−0.79	+2.0	+0.5
28	Greenwich	θ^2 Tauri	I	−0.82	+0.54	+0.14	−0.64	+0.65	−0.03	+0.13	+0.58	−0.63	+1.1	−0.1
28	Greenwich	264 B. Tauri	I	−1.00	+0.65	−0.08	+0.37	−0.38	−0.20	+0.12	−0.36	−0.77	+4.9	+3.4
28	Greenwich	85 Tauri	I	−0.41	−0.26	+0.18	+0.91	+0.93	+0.05	+0.06	+0.84	−0.31	+2.5	+1.9
28	Camb., Eng.	85 Tauri	I	−0.47	−0.31	+0.18	−0.88	+0.90	+0.06	+0.08	+0.80	−0.36	+2.0	+1.3
28	Dorchester	α Tauri	I	−1.02	−0.67	−0.06	+0.31	−0.32	−0.19	+0.12	−0.32	−8.78	+1.7	+0.2
28	Dorchester	α Tauri	EB	+1.02	+0.67	−0.06	−0.31	−0.31	+0.11	−0.14	−0.28	+0.78	−3.0	−1.9
29	Berlin	111 Tauri	EB	+1.04	+0.53	0.00	+0.13	−0.13	+0.12	−0.07	−0.12	+0.91	+1.9	+0.6
29	Berlin	117 Tauri	I	−0.90	−0.46	−0.02	−0.51	+0.51	−0.07	+0.08	+0.48	−0.78	−3.9	−2.8
29	Greenwich	117 Tauri	I	−0.78	−0.40	−0.02	−0.67	−0.67	−0.05	+0.05	+0.65	−0.67	+2.3	+1.2
29	Camb., Eng.	117 Tauri	I	−0.66	−0.42	−0.03	−0.77	+0.77	+0.09	+0.06	+0.60	−0.70	+3.5	+2.5
Apr. 5	Greenwich	τ Leonis	I	−0.90	+0.85	−0.10	0.00	+0.10	+0.02	−0.28	+0.01	−0.50	+2.1	+0.8
5	Camb., Eng.	τ Leonis	I	−0.90	+0.86	−0.06	0.00	+0.06	+0.03	−0.31	+0.01	−0.50	+2.3	+1.0
28	Cracow	1 Cancri	I	−0.85	0.00	−0.32	−0.39	+0.51	−0.08	−0.19	+0.48	−0.86	+1.2	−0.1
28	Berlin	1 Cancri	I	−0.86	+0.02	−0.32	−0.39	+0.51	−0.11	−0.10	+0.44	−0.83	+0.5	−0.8
May 1	Camb., Eng.	48 Leonis	I	−0.90	+0.65	+0.15	+0.03	−0.15	+0.07	−0.28	−0.07	−0.92	+2.9	+1.6
1	Cracow	48 Leonis	I	−0.86	+0.62	+0.32	+0.06	−0.32	+0.13	−0.37	−0.14	−0.85	+1.9	+0.6
June 4	Cracow	η Libræ	I	−0.75	+0.67	+0.20	−0.55	−0.59	+0.12	−0.13	+0.48	−0.23	+1.8	+0.7
25	Cracow	ο Sextantis	I	−0.84	+0.55	−0.44	−0.04	+0.44	−0.11	−0.33	+0.16	−0.82	−3.1	−4.3
July 15	Dorchester	α Tauri	IB	−0.63	−0.48	−0.08	+0.81	−0.81	−0.21	+0.08	−0.77	+0.45	0.0	−0.9
16	Cracow	α Tauri	IB	−0.71	−0.53	−0.06	+0.75	−0.76	−0.18	+0.03	−0.71	+0.44	+0.7	−0.3
Aug. 1	Cracow	110 B. Sagittarii	I	−0.90	+0.28	−0.17	−0.38	−0.41	−0.04	0.00	+0.39	+0.45	+0.2	−1.1
Sept. 5	Berlin	ν Piscium	IB	−0.86	−0.75	+0.47	−0.43	+0.64	+0.06	+0.26	+0.21	+0.46	−2.4	−3.6
5	Berlin	ν Piscium	E	+0.80	+0.71	+0.51	−0.48	+0.70	+0.33	−0.18	+0.32	−0.43	−1.6	−0.8
Oct. 5	Greenwich	θ^1 Tauri	IB	−1.10	−0.91	−0.01	+0.13	−0.14	−0.21	+0.15	−0.15	+0.71	+1.0	−0.6
5	Greenwich	θ^2 Tauri	IB	−1.09	−0.88	+0.01	−0.20	+0.20	−0.13	+0.17	+0.15	+0.70	+0.5	−1.1
5	Greenwich	85 Tauri	IB	−0.53	−0.45	+0.03	−0.88	+0.88	+0.05	+0.08	+0.79	+0.36	−4.7	−5.5
20	Berlin	24 Scorpii	I	−0.59	+0.55	−0.02	−0.75	−0.76	+0.12	−0.10	+0.69	−0.46	+1.5	+0.6
20	Cracow	24 Scorpii	I	−0.67	+0.62	−0.02	−0.67	−0.67	+0.12	−0.04	+0.60	−0.56	+2.5	+1.5
23	Cracow	d Sagittarii	I	−0.95	+0.29	−0.02	−0.02	−0.02	−0.01	+0.18	−0.03	−0.98	+0.9	−0.5
30	Berlin	ν Piscium	I	−0.76	−0.64	+0.52	−0.54	+0.75	+0.09	+0.24	+0.26	−0.17	+0.8	−0.3
Dec. 22	Cracow	29 Piscium	I	−0.90	−0.62	+0.48	−0.19	+0.52	+0.08	+0.34	−0.01	−0.84	+0.9	−0.4
1831, Jan. 20	Cracow	ν Piscium	I	−1.02	−0.88	+0.18	−0.23	+0.29	−0.03	+0.30	+0.06	−0.96	+4.3	+2.9
20	Berlin	ν Piscium	I	−1.06	−0.91	+0.07	−0.09	+0.11	−0.09	+0.30	−0.01	−0.99	+4.4	+2.9
21	Dorchester	μ Ceti	I	−0.80	−0.74	−0.26	+0.62	+0.67	+0.06	+0.23	+0.38	−0.72	+5.2	+4.1
21	Berlin	μ Ceti	I	−0.89	−0.82	+0.21	−0.52	+0.56	+0.02	+0.25	+0.32	−0.82	+1.2	0.0
22	Cracow	f Tauri	I	−0.47	−0.43	+0.17	−0.88	+0.90	+0.15	+0.10	+0.68	−0.46	+0.5	−0.2
26	Greenwich	f Geminor.	I	−0.97	−0.49	+0.32	+0.29	−0.43	−0.10	−0.10	−0.43	−0.29	+2.4	+1.0
Feb. 4	Dorchester	γ Libræ	IB	−0.79	+0.86	−0.08	+0.47	+0.47	−0.07	−0.19	−0.39	+0.88	−2.8	−3.9
4	Dorchester	γ Libræ	E	+0.87	−0.95	−0.04	+0.23	+0.23	−0.08	+0.23	−0.15	−0.97	−3.8	−2.9
19	Cracow	48 Tauri	I	−1.08	−0.98	0.00	−0.04	+0.04	−0.12	+0.11	−0.01	−1.00	+2.3	+0.8
19	Greenwich	48 Tauri	I	−1.07	−0.98	0.00	+0.13	−0.13	−0.18	+0.19	−0.16	−0.98	+3.9	+2.4
19	Cracow	ξγ Tauri	I	−1.04	−0.95	+0.01	+0.25	−0.25	−0.17	+0.10	−0.27	−0.94	+2.8	+1.4

GROUP IX—1821–1838—Continued.

Date.		Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
														″	″
1831, Feb.	19	Dorchester	α Tauri	I	−0.49	−0.45	+0.11	+0.88	−0.89	−0.20	+0.06	−0.84	−0.45	+2.6	+1.9
	20	Greenwich	111 Tauri	I	−0.77	−0.66	−0.22	−0.66	+0.69	−0.04	+0.08	+0.65	−0.68	+1.5	+0.4
	20	Camb., Eng.	111 Tauri	I	−0.80	−0.69	−0.21	−0.63	+0.66	−0.05	+0.07	+0.62	−0.73	+1.1	0.0
Apr.	15	Berlin	α Tauri	I	−1.01	−0.88	+0.07	+0.44	−0.45	−0.27	+0.15	−0.47	−0.61	+3.6	+2.2
May	22	Greenwich	*l* Virginis	I	−0.76	+0.57	−0.32	+0.46	+0.56	−0.17	−0.24	−0.23	−0.61	+1.7	+0.6
June	21	Greenwich	γ Libræ	I	−0.83	+0.89	+0.02	−0.39	−0.39	−0.07	+0.21	+0.28	−0.55	+2.8	+1.7
	21	Cracow	γ Libræ	I	−0.73	+0.78	+0.02	−0.59	−0.59	+0.16	−0.13	+0.45	−0.53	+2.7	+1.7
July	31	Greenwich	ξ^2 Ceti	E	+1.03	+0.83	−0.08	+0.25	−0.26	+0.04	−0.30	−0.08	−0.96	−0.3	+0.7
Aug.	28	Dorchester	*f* Tauri	IB	−0.85	−0.73	0.00	−0.61	+0.61	+0.01	+0.21	+0.56	+0.77	−2.0	−3.2
	29	Dorchester	γ Tauri	IB	−0.84	−0.76	+0.13	+0.61	−0.62	−0.24	+0.14	−0.61	+0.78	−1.9	−3.0
	29	Dorchester	γ Tauri	E	+0.96	+0.87	+0.10	+0.45	−0.46	+0.06	−0.17	−0.36	−0.89	−1.7	−0.8
	29	Dorchester	α Tauri	IB	−1.07	−0.98	−0.02	−0.08	+0.09	−0.15	+0.20	+0.02	+1.00	+1.1	−0.3
	29	Dorchester	θ^1 Tauri	IB	−0.34	−0.50	+0.23	+0.92	+0.95	+0.53	+0.19	+0.43	+0.85	−3.1	−3.6
	29	Dorchester	θ^2 Tauri	IB	−0.39	−0.35	−0.23	−0.90	+0.93	+0.10	+0.08	+0.84	+0.36	−0.1	−0.6
	29	Dorchester	θ^2 Tauri	E	+0.15	+0.14	−0.25	−0.96	+0.99	+0.20	−0.01	+0.90	−0.14	−2.2	−2.0
Oct.	14	Dorchester	π Capricor.	I	−0.78	+0.55	−0.52	−0.15	−0.54	−0.06	+0.09	+0.40	−0.81	+4.1	+3.1
	21	Greenwich	ξ^2 Ceti	IB	−0.98	−0.65	+0.11	−0.48	+0.49	−0.03	+0.28	+0.24	+0.11	+0.8	−0.5
	21	Greenwich	ξ^2 Ceti	E	+0.86	+0.57	+0.14	−0.62	+0.64	+0.35	−0.21	+0.42	−0.08	−2.0	−1.1
	23	Greenwich	θ^1 Tauri	IB	−0.98	−0.84	−0.14	−0.47	+0.50	−0.10	+0.19	+0.39	+0.48	+0.2	−1.1
	23	Greenwich	θ^2 Tauri	IB	−0.56	−0.48	−0.25	−0.83	+0.87	+0.07	+0.11	+0.75	+0.28	−1.3	−2.0
	23	Greenwich	75 Tauri	I	−0.54	−0.48	+0.26	+0.84	−0.88	−0.27	+0.08	0.83	+0.27	2.7	−3.4
	23	Greenwich	θ^1 Tauri	E	+0.86	+0.75	−0.19	−0.62	+0.65	+0.28	−0.15	+0.64	−0.42	−1.6	−0.7
	23	Greenwich	75 Tauri	E	+0.73	+0.62	+0.23	+0.73	−0.77	0.00	−0.15	−0.64	−0.35	−1.3	−0.6
	23	Greenwich	99 Tauri	E	+1.06	+0.91	−0.10	−0.33	+0.34	+0.27	−0.19	+0.35	−0.52	−0.1	+0.9
	23	Dorchester	α Tauri	IB	−1.02	−0.88	+0.13	+0.40	−0.42	−0.26	+0.15	−0.44	+0.52	−0.9	−2.2
	23	Dorchester	α Tauri	E	+1.08	+0.93	+0.09	+0.26	−0.28	+0.15	−0.19	−0.19	−0.55	−2.9	−1.9
	23	Greenwich	α Tauri	IB	−1.07	−0.92	−0.10	−0.29	+0.31	−0.15	+0.19	+0.23	+0.53	+1.2	−0.2
	23	Camb., Eng.	α Tauri	IB	−1.08	−0.93	−0.09	−0.26	+0.28	−0.15	+0.19	+0.19	+0.53	+2.7	+1.3
	23	Camb., Eng.	α Tauri	E	+1.02	+0.88	−0.14	−0.40	+0.42	+0.27	−0.17	+0.45	−0.50	−2.3	−1.3
	23	Greenwich	α Tauri	E	+1.00	+0.86	−0.15	−0.43	+0.46	+0.27	0.17	+0.48	0.49	−1.6	−0.6
	23	Cracow	α Tauri	IB	−0.88	−0.77	−0.20	−0.59	+0.62	−0.04	+0.06	+0.54	+0.48	+1.1	−0.1
	23	Cracow	α Tauri	E	+0.83	+0.72	−0.23	−0.64	+0.68	+0.25	−0.04	+0.67	−0.38	−1.9	−1.2
Nov.	16	Greenwich	33 Ceti	I	−0.71	−0.30	−0.39	+0.64	−0.75	−0.35	+0.17	−0.25	−0.35	+0.7	−0.2
	24	Greenwich	π Cancri	E	+0.23	+0.16	−0.98	−0.04	+0.98	−0.16	+0.06	+0.70	−0.20	0.0	+0.2
Dec.	17	Cracow	γ Tauri	I	−1.11	−0.90	−0.08	−0.26	+0.27	−0.15	+0.09	+0.18	−0.35	+1.3	−0.2
	17	Berlin	γ Tauri	I	−1.14	−0.93	−0.04	−0.13	+0.14	−0.20	+0.21	+0.05	−0.35	+1.3	−0.2
	18	Greenwich	119 Tauri	I	−1.08	−0.93	+0.21	+0.30	−0.37	−0.27	+0.12	−0.43	−0.11	−0.2	−1.6
1832, Jan.	5	Cracow	θ Capricor.	I	−0.91	+0.76	−0.12	0.00	−0.12	−0.02	+0.26	0.00	−0.53	+1.3	+0.1
Feb.	10	Cracow	α Tauri	I	−0.97	−0.83	−0.18	−0.40	+0.44	−0.04	+0.07	+0.35	−0.88	+3.2	+1.9
	10	Cracow	α Tauri	EB	+0.89	+0.76	−0.25	−0.52	+0.58	+0.22	−0.05	+0.58	+0.69	−2.0	−1.2
	15	Berlin	ψ Leonis	I	−0.92	−0.72	+0.55	+0.06	−0.55	−0.03	−0.20	−0.40	−0.07	+1.0	−0.2
	15	Berlin	α Leonis	I	−1.10	−0.80	−0.05	0.00	+0.05	−0.21	−0.23	−0.03	−0.08	−4.1	−5.5
	15	Cracow	α Leonis	I	−1.10	−0.64	−0.04	−0.01	+0.04	−0.17	−0.30	+0.08	−0.08	+1.4	0.0
Mar.	8	Cracow	75 Tauri	I	−1.02	−0.86	−0.12	−0.26	+0.29	−0.06	+0.08	+0.20	−0.97	+2.8	+1.5
	9	Cracow	119 Tauri	I	−1.06	−0.97	−0.07	−0.09	+0.11	−0.12	0.00	+0.04	−1.00	−0.2	−1.6
Apr.	14	Berlin	80 Virginis	I	−0.97	+0.12	+0.07	−0.21	−0.22	+0.01	−0.34	+0.04	−0.14	−3.9	−5.2
June	17	Dorchester	δ Capricor.	IB	−0.49	+0.43	+0.81	−0.23	+0.84	+0.20	+0.14	−0.56	+0.47	−4.4	−5.0
	17	Dorchester	δ Capricor.	E	+0.37	−0.32	+0.87	−0.25	+0.91	+0.19	−0.07	−0.54	−0.35	−0.8	−0.5
Sept.	4	Cracow	ο Sagittarii	I	−0.85	+0.92	+0.31	+0.10	+0.33	+0.03	+0.11	−0.40	−0.81	+2.3	+1.2
	7	Dorchester	δ Capricor.	I	−0.76	+0.74	+0.52	−0.19	−0.55	+0.14	+0.22	−0.41	−0.35	+1.5	+0.5
Dec.	31	Cracow	311 B. Piscium	I	−0.97	+0.06	−0.01	−0.23	+0.23	+0.02	+0.37	+0.01	−0.88	+3.3	+2.1
1833, Mar.	31	Cracow	8 Leonis	I	−0.58	−0.52	+0.75	−0.40	−0.85	+0.09	−0.15	−0.60	−0.37	+1.2	+0.5
Dec.	26	Berlin	μ Geminor.	IB	−0.66	−0.20	+0.78	+0.05	−0.78	−0.14	+0.04	−0.83	+0.02	−0.8	−1.5
1834, Apr.	13	Cracow	330 B. Tauri	I	−0.63	+0.12	+0.72	+0.19	−0.75	−0.14	+0.11	−0.79	−0.58	+3.2	+2.5
	20	Cracow	ν Virginis	I	−0.80	−0.69	+0.11	−0.71	−0.72	+0.11	−0.27	−0.16	−0.44	+2.3	+1.4
July	14	Cape	8 G. Libræ	I	−0.99	−0.86	−0.25	−0.29	−0.38	−0.02	−0.38	+0.19	−0.91	+3.7	+2.7
Aug.	12	Berlin	β Scorpii	I	−0.84	−0.60	+0.54	+0.23	+0.59	−0.26	−0.20	−0.56	−0.81	+1.0	+0.1
	12	Berlin	β Scorpii	EB	+0.89	+0.63	+0.49	+0.20	+0.53	−0.01	+0.25	−0.43	+0.85	−4.4	−3.9
	30	Cape	κ Geminor.	E	+1.03	+0.19	+0.06	−0.03	−0.06	+0.13	−0.07	−0.05	−0.64	−6.8	−6.1
Oct.	7	Cracow	33 Scorpii	I	−0.98	−0.54	+0.36	+0.01	+0.36	−0.20	−0.06	−0.44	−0.75	+1.3	+0.3
	7	Cracow	44 Ophiuchi	I	−1.05	−0.58	−0.02	0.00	−0.02	−0.15	−0.07	−0.07	−0.83	+3.2	+2.1
	7	Berlin	44 Ophiuchi	I	−1.04	−0.61	−0.12	0.00	−0.12	−0.12	−0.16	+0.03	−0.82	+1.6	+0.5
	8	Berlin	λ Sagittarii	I	−1.00	−0.40	−0.19	+0.05	−0.20	−0.09	−0.07	+0.10	−0.91	+2.7	+1.7
	8	Cracow	λ Sagittarii	I	−1.01	−0.37	−0.07	+0.02	−0.07	−0.11	+0.02	−0.02	−0.93	+3.0	+2.0
Nov.	3	Cracow	24 Ophiuchi	I	−1.09	−0.69	−0.13	−0.01	−0.13	−0.17	−0.13	+0.04	−0.41	+1.6	+0.5
1835, Jan.	6	Cracow	35 Ceti	I	−0.67	+0.71	−0.33	−0.58	−0.67	−0.28	+0.25	−0.25	−0.74	+3.5	+2.8
	18	Cape	ξ Virginis	IB	−0.76	−0.55	−0.06	−0.70	−0.70	+0.16	−0.35	−0.19	+0.59	−2.0	−2.8
	18	Cape	ξ Virginis	E	+0.53	+0.39	−0.09	−0.86	−0.87	+0.43	+0.11	−0.10	−0.42	−0.3	0.0
Apr.	9	Cracow	46 Leonis	I	−1.04	−0.44	+0.04	−0.23	−0.24	−0.07	−0.27	−0.16	−0.61	+2.9	+1.9
June	10	Cracow	θ Ophiuchi	I	−1.06	−0.82	−0.36	+0.07	−0.36	−0.17	−0.08	+0.28	−0.06	+1.5	+0.5

GROUP IX—1821–1838—Continued.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	h_0	α_0	δ_0	ε	P	n	n′
													″	″
1835, June 12	Cape	h Sagittarii	IB	−1.01	−0.52	−0.28	−0.24	−0.37	−0.21	+0.07	+0.30	+0.35	+ 2.6	+ 1.6
14	Cape	ε Capricor.	IB	−0.84	−0.11	−0.20	−0.53	+0.57	+0.04	+0.26	−0.41	+0.61	+ 0.3	− 0.5
July 6	Cracow	λ Libræ	I	−0.75	−0.67	−0.73	−0.11	−0.74	+0.07	−0.17	+0.57	−0.53	+ 0.8	+ 0.1
Aug. 6	Cape	51 Sagittarii	I	−0.76	−0.48	−0.51	+0.49	−0.71	−0.18	+0.05	+0.60	−0.35	+ 2.7	+ 2.0
6	Cape	h Sagittarii	I	−1.07	−0.67	−0.06	+0.06	−0.08	−0.19	+0.08	+0.06	−0.50	+ 1.7	+ 0.7
6	Cape	h Sagittarii	EB	+1.02	+0.64	−0.21	+0.21	−0.30	+0.15	−0.09	+0.31	+0.48	−12.1	−11.5
8	Cape	κ Capricor.	IB	−0.87	−0.18	+0.15	−0.52	+0.54	+0.02	+0.28	−0.37	−0.05	− 2.0	− 2.8
29	Cracow	26 Libræ	I	−1.04	−0.96	+0.23	+0.06	+0.24	−0.25	−0.22	−0.25	−0.88	+ 1.7	+ 0.7
Oct. 3	Cracow	69 Aquarii	I	−0.95	−0.02	+0.02	+0.25	−0.25	−0.17	+0.25	+0.02	−0.63	+ 2.1	+ 1.2
29	Cape	κ Capricor.	I	−0.86	−0.31	−0.10	+0.49	−0.50	−0.24	+0.23	+0.25	−0.87	+ 7.1	+ 6.3
Nov. 25	Cracow	35 Capricor.	I	−1.04	−0.44	0.00	+0.01	−0.01	−0.14	+0.19	−0.07	−0.90	+ 4.6	+ 3.7
1836, Feb. 8	Cape	4 G. Libræ	E	+0.93	+0.73	−0.43	−0.16	−0.46	+0.32	+0.32	+0.27	−0.88	+ 6.9	+ 7.4
23	Cracow	14 Tauri	I	−0.86	+0.88	−0.29	−0.01	−0.29	−0.09	+0.28	−0.30	−0.95	+ 2.1	+ 1.3
25	Cracow	118 Tauri	I	−0.87	+0.96	−0.23	+0.12	+0.26	+0.02	+0.12	+0.18	−0.93	+ 4.8	+ 4.0
Apr. 25	Berlin	η Leonis	I	−0.59	+0.22	−0.06	−0.79	−0.79	+0.23	−0.24	−0.46	−0.55	+ 0.5	0.0
25	Berlin	η Leonis	EB	+0.32	−0.12	−0.08	−0.94	−0.94	+0.32	+0.05	−0.52	+0.29	− 2.7	− 2.5
25	Cracow	η Leonis	I	−0.44	+0.17	−0.07	−0.89	−0.89	+0.25	−0.16	−0.51	−0.48	+ 1.4	+ 1.0
May 17	Berlin	118 Tauri	I	−0.43	+0.48	−0.74	−0.46	+0.88	+0.12	+0.07	+0.84	−0.21	+ 0.8	+ 0.4
Aug. 22	Cape	φ Sagittarii	I	−1.11	−1.00	−0.03	+0.04	−0.05	−0.24	+0.50	+0.04	−0.78	− 1.0	− 1.9
22	Cape	φ Sagittarii	EB	+1.16	+1.00	−0.02	+0.03	−0.04	+0.29	−0.34	+0.05	+0.78	− 2.5	− 2.0
Sept. 16	Cape	ρ Ophiuchi	I	−0.90	−0.74	−0.49	+0.21	−0.53	−0.03	−0.23	+0.45	−0.82	+ 4.5	+ 3.7
21	Cape	ε Capricor.	I	−1.07	−0.82	+0.01	+0.16	−0.16	−0.15	+0.52	+0.03	−0.70	+ 0.6	− 0.3
Oct. 21	Cape	27 Piscium	I	−0.75	−0.27	+0.48	+0.49	−0.68	−0.42	+0.25	0.00	−0.44	+ 1.8	+ 1.2
21	Cape	29 Piscium	I	−0.98	−0.36	+0.21	+0.20	−0.29	−0.27	+0.40	−0.04	−0.56	+ 2.3	+ 1.5
1837, Feb. 14	Cracow	112 B. Aurigæ	I	−0.73	+0.65	+0.40	−0.43	−0.59	−0.07	+0.09	−0.62	−0.74	+ 1.4	+ 0.8
17	Berlin	λ Cancri	I	−0.18	+0.19	−0.10	+0.97	+0.98	−0.16	−0.02	+0.84	−0.09	+ 2.1	+ 1.9
Mar. 12	Berlin	62 Tauri	I	−0.75	+0.42	+0.52	−0.33	−0.61	−0.16	+0.16	−0.63	−0.74	+ 2.6	+ 2.0
15	Cracow	47 Geminor.	I	−0.86	+0.91	−0.11	+0.29	+0.31	−0.02	+0.05	+0.25	−0.88	+ 2.7	+ 2.0
May 10	Cracow	λ Cancri	I	−0.69	+0.76	−0.01	+0.65	+0.65	−0.12	−0.07	+0.53	−0.67	+ 0.1	− 0.4
June 6	Cracow	4 Cancri	I	−0.77	+0.82	−0.04	−0.52	−0.52	+0.08	−0.14	−0.51	−0.55	+ 2.1	+ 1.5
16	Cape	δ Scorpii	I	−0.72	−0.29	−0.64	+0.38	−0.74	+0.06	−0.23	+0.62	−0.23	+ 1.2	+ 0.6
July 9	Berlin	η Virginis	EB	+0.92	−0.56	−0.08	−0.04	−0.08	+0.07	+0.44	+0.03	+0.99	− 3.6	− 3.3
Aug. 11	Cape	O. A. 16481	I	−1.07	−0.62	0.00	0.00	0.00	−0.20	−0.14	−0.03	−0.83	− 0.2	− 1.0
18	Berlin	10 Ceti	IB	−1.10	−0.75	+0.03	+0.01	−0.03	−0.23	+0.46	−0.06	+0.51	− 1.2	− 2.0
18	Berlin	10 Ceti	E	+1.09	+0.73	−0.16	−0.06	+0.17	+0.30	−0.45	+0.07	−0.50	− 0.9	− 0.6
Oct. 9	Berlin	143 B. Capricor.	I	−1.07	−0.97	+0.11	+0.22	−0.24	−0.26	+0.31	+0.13	−0.82	+ 1.1	+ 0.3
9	Berlin	143 B. Capricor.	EB	+1.10	+1.00	0.00	+0.01	−0.01	+0.17	+0.24	+0.04	+0.85	− 5.4	− 5.1
Nov. 5	Berlin	35 Capricor.	I	−0.71	−0.66	−0.31	−0.68	+0.75	+0.12	+0.24	−0.55	−0.67	0.0	− 0.5
10	Cracow	54 Ceti	I	−0.80	−0.42	−0.65	+0.07	+0.66	+0.15	+0.34	+0.26	−0.36	+ 0.8	+ 0.2
1838, Jan. 3	Cracow	88 Piscium	I	−1.03	−0.74	−0.15	0.00	+0.15	−0.09	+0.38	+0.01	−1.00	− 0.4	− 1.1
Feb. 4	Cracow	107 B. Aurigæ	I	−0.95	+0.18	−0.02	−0.04	−0.04	−0.06	+0.10	+0.01	−0.86	+ 1.6	+ 0.9
Mar. 1	Cracow	τ Arietis	I	−0.67	−0.26	−0.60	+0.44	+0.74	+0.15	+0.22	+0.57	−0.60	+ 0.1	− 0.4
June 4	Cracow	40 H. Virginis	I	−0.50	+0.35	−0.78	−0.33	+0.85	−0.36	+0.14	−0.48	−0.31	+ 0.6	+ 0.3
July 31	Berlin	65 B. Scorpii	I	−0.94	+0.26	+0.13	−0.19	+0.23	−0.34	−0.09	−0.30	−0.81	+ 4.3	+ 3.6
Aug. 12	Cape	q Tauri	E	+0.74	+0.43	−0.44	+0.53	+0.69	+0.29	−0.17	+0.59	−0.72	− 1.2	− 1.0
Sept. 2	Cracow	κ Capricor.	I	−0.99	−0.70	−0.33	−0.35	+0.48	−0.06	+0.24	−0.32	−0.30	+ 1.2	+ 0.6
8	Berlin	ζ Arietis	IB	−1.05	−0.72	+0.14	−0.13	−0.19	−0.22	+0.31	−0.17	+0.80	− 4.6	− 5.3
Oct. 5	Cape	ε Arietis	E	+0.88	+0.62	−0.45	+0.42	+0.61	+0.04	+0.30	+0.44	−0.38	− 7.8	− 7.6
25	Cracow	A Sagittarii	I	−0.61	−0.26	+0.33	+0.74	−0.80	−0.23	+0.04	+0.73	−0.50	− 0.3	− 0.7
25	Berlin	A Sagittarii	I	−0.26	−0.11	+0.36	+0.90	−0.97	−0.19	+0.03	+0.93	−0.26	+ 0.8	+ 0.6
Nov. 3	Berlin	χ Tauri	IB	−0.64	−0.35	+0.36	−0.72	−0.81	−0.28	+0.11	−0.75	+0.17	+ 0.4	0.0
27	Cracow	171 B. Piscium	I	−0.89	−0.81	−0.57	−0.13	−0.59	+0.10	+0.45	+0.13	−0.63	− 1.0	− 1.6
29	Cape	ε Arietis	I	−0.82	−0.61	−0.47	+0.48	+0.67	+0.04	+0.30	+0.49	−0.32	− 0.1	− 0.6
Dec. 26	Berlin	27 Arietis	I	−0.90	−0.75	+0.43	−0.35	−0.55	−0.36	+0.27	−0.42	−0.71	+ 2.4	+ 1.8
26	Cracow	27 Arietis	I	−1.01	−0.85	+0.27	−0.22	−0.35	−0.31	+0.33	−0.22	−0.80	+ 0.9	+ 0.3

GROUP X—1839–1856.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	h_0	α_0	δ_0	ε	P	n	n′
1839, Apr. 20	Dorchester	γ Cancri	I	−0.81	+0.06	+0.38	+0.41	+0.56	−0.21	−0.21	+0.54	−0.83	−0.3	−0.8
May 2	Berlin	W Sagittarii	E	+0.79	−0.30	−0.06	−0.54	+0.54	+0.02	0.00	−0.55	−0.69	+1.4	+1.5
6	Cape	δ Capricor.	E	+0.98	+0.50	+0.25	+0.15	−0.29	+0.04	−0.40	+0.24	−0.92	0.0	+0.2
24	Cape	α Virginis	I	−0.04	−0.05	+0.87	−0.50	+1.00	−0.43	+0.09	−0.38	−0.03	−2.3	−2.3
24	Cape	α Virginis	EB	+0.36	+0.41	+0.79	−0.46	+0.92	−0.39	+0.28	−0.37	+0.28	0.0	+0.1
June 20	Dorchester	68 Virginis	I	−0.78	−0.85	+0.43	+0.27	−0.50	+0.21	+0.59	+0.21	+0.81	−3.3	−3.8
23	Washington	b Scorpii	I	−0.92	+0.87	+0.04	−0.10	+0.11	−0.04	−0.23	−0.07	−0.51	+0.9	+0.4
23	Dorchester	b Scorpii	I	−0.91	+0.87	−0.04	+0.12	−0.13	+0.02	−0.24	−0.02	−0.51	+1.1	+0.6
24	Cape	α Scorpii	I	−0.81	−0.88	−0.06	+0.47	−0.48	+0.03	−0.18	+0.44	−0.34	+1.5	+1.0
July 1	Dorchester	φ Aquarii	I	−0.97	−0.67	+0.36	+0.03	−0.37	−0.32	+0.40	+0.10	−0.31	+0.2	−0.3

GROUP X—1839–1856—Continued.

Date.		Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ι	P	n	n'
														″	″
1839, July	1	Dorchester	φ Aquarii	EB	+0.92	+0.72	+0.06	0.00	−0.06	+0.02	−0.46	+0.01	+0.33	−0.9	−0.8
	6	Washington	20 Tauri	IB	−0.33	−0.27	+0.36	−0.89	−0.95	−0.28	+0.04	−0.81	+0.22	+0.4	+0.2
	6	Washington	17 Tauri	E	+1.07	+0.90	+0.08	−0.19	−0.21	+0.13	−0.25	−0.18	−0.73	+0.4	+0.6
	6	Washington	η Tauri	IB	−1.00	−0.84	+0.15	+0.37	+0.41	−0.08	+0.24	+0.36	+0.68	−0.3	−0.8
	6	Washington	20 Tauri	E	+0.67	+0.57	+0.29	−0.73	−0.79	−0.07	−0.17	−0.67	−0.47	−3.9	−3.8
	23	Cracow	W' Sagittarii	I	−0.60	+0.32	−0.14	−0.77	+0.78	−0.04	+0.01	−0.63	−0.30	+1.1	+0.8
Aug.	17	Cape	A^1 Scorpii	I	−0.90	+0.90	+0.04	−0.13	+0.14	−0.07	−0.24	−0.06	−0.98	+1.6	+1.1
	17	Cape	A^2 Scorpii	I	−0.87	+0.87	−0.08	+0.27	−0.29	+0.03	+0.10	+0.27	−0.95	+0.4	−0.1
	25	Cracow	φ Aquarii	IB	−1.09	−0.65	−0.09	0.00	+0.09	−0.17	+0.38	−0.02	+0.24	−1.5	−2.1
Sept.	26	Berlin	66 Arietis	E	+0.38	+0.34	−0.35	+0.87	+0.94	+0.29	−0.06	+0.75	−0.24	−1.3	−1.2
	26	Washington	20 Tauri	IB	−1.07	−0.95	+0.09	−0.27	−0.28	−0.25	+0.22	−0.22	+0.67	−5.8	−6.4
	26	Washington	17 Tauri	E	+0.94	+0.83	−0.17	+0.51	+0.54	+0.28	−0.18	+0.45	−0.59	−0.9	−0.8
	26	Washington	16 Tauri	E	+1.11	+0.99	+0.01	−0.05	−0.05	+0.19	−0.24	−0.05	−0.70	+1.1	+1.2
	26	Washington	q Tauri	E	+0.94	+0.85	+0.16	−0.51	−0.54	+0.05	−0.22	−0.46	−0.60	+0.8	+0.9
	26	Washington	20 Tauri	E	+1.11	+0.99	−0.01	+0.04	+0.04	+0.21	−0.24	+0.02	−0.70	−0.8	−0.7
	26	Berlin	20 Tauri	IB	−0.74	−0.66	−0.22	+0.71	+0.74	+0.03	+0.17	+0.65	+0.47	−0.2	−0.6
Oct.	17	Washington	δ Capricor.	I	−0.46	−0.11	+0.83	+0.34	−0.89	−0.39	+0.11	+0.58	−0.39	+1.9	+1.6
	18	Berlin	58 Aquarii	I	−0.96	−0.40	+0.40	+0.07	−0.41	−0.33	+0.36	+0.20	−0.66	+3.5	+3.0
	18	Cracow	58 Aquarii	I	−1.01	−0.42	+0.17	+0.05	−0.17	−0.22	+0.31	+0.10	−0.69	+1.1	+0.6
	19	Cracow	φ Aquarii	I	−1.04	−0.56	−0.35	+0.01	+0.35	−0.06	+0.39	−0.09	−0.56	+0.1	−0.5
	19	Cracow	96 Aquarii	I	−1.02	−0.54	−0.43	+0.02	+0.43	−0.03	+0.41	−0.09	−0.54	+2.6	+2.1
Nov.	14	Cracow	ι Aquarii	I	−1.00	−0.26	+0.16	+0.05	−0.16	−0.14	+0.40	+0.05	−0.98	+0.6	+0.1
	20	Washington	17 Tauri	I	−1.13	−0.96	+0.06	−0.23	−0.24	−0.29	+0.21	−0.18	−0.08	−8.0	−8.6
	20	Dorchester	17 Tauri	I	−1.14	−0.97	+0.06	−0.20	−0.21	−0.29	+0.23	−0.16	−0.08	−7.4	−8.0
	20	Dorchester	20 Tauri	I	−0.82	−0.70	+0.18	−0.68	−0.71	−0.32	+0.14	−0.58	−0.06	−4.9	−5.3
	20	Washington	η Tauri	I	−0.90	−0.76	−0.16	+0.62	+0.64	−0.05	+0.20	+0.55	−0.06	−6.7	−7.2
	20	Washington	η Tauri	EB	+0.60	+0.51	−0.22	+0.83	+0.86	+0.31	−0.09	+0.72	+0.04	−6.2	−6.1
	20	Dorchester	η Tauri	I	−0.84	−0.71	+0.17	+0.67	+0.69	−0.02	+0.20	+0.60	−0.06	−1.5	−1.9
Dec.	12	Washington	78 Aquarii	I	−0.97	−0.42	+0.25	0.00	−0.25	−0.24	+0.43	+0.12	−0.96	+5.9	+5.4
1840, Jan.	11	Berlin	δ Piscium	I	−1.02	−0.77	−0.18	+0.11	+0.21	−0.05	+0.47	+0.07	−0.98	+0.1	−0.4
	11	Berlin	δ Piscium	EB	+0.90	+0.68	−0.43	+0.28	+0.52	+0.37	−0.33	+0.09	+0.86	−1.7	−1.6
	13	Berlin	μ Arietis	I	−0.87	−0.79	−0.27	+0.54	+0.60	+0.04	+0.29	+0.42	−0.74	+0.2	−0.2
	13	Berlin	μ Arietis	EB	+0.79	+0.72	−0.30	+0.61	+0.68	+0.34	−0.20	+0.44	+0.67	−8.4	−8.3
	13	Cracow	μ Arietis	I	−0.63	−0.57	−0.37	+0.73	+0.82	+0.14	+0.25	+0.56	−0.52	−1.3	−1.6
	14	Cracow	q Tauri	I	−0.80	−0.72	−0.13	+0.68	+0.69	−0.02	+0.18	+0.62	−0.58	−1.0	−1.4
	14	Cracow	21 Tauri	I	−0.95	−0.85	−0.10	+0.50	+0.51	−0.10	+0.21	+0.60	−0.69	−0.3	−0.8
	14	Cracow	22 Tauri	I	−0.86	−0.78	−0.12	+0.62	+0.63	−0.04	+0.19	+0.68	−0.62	−1.8	−2.2
	14	Berlin	q Tauri	I	−0.93	−0.83	−0.11	+0.53	+0.54	−0.05	+0.21	+0.48	−0.67	0.0	−0.5
	14	Berlin	18 Tauri	I	−0.87	−0.78	+0.12	−0.60	−0.61	−0.28	+0.16	−0.50	−0.63	+1.9	+1.5
	14	Berlin	q Tauri	EB	+0.93	+0.84	−0.10	+0.52	+0.53	+0.26	−0.18	+0.45	+0.68	−5.6	−5.5
	16	Cracow	406 B. Tauri	I	−1.05	−0.85	−0.08	−0.27	−0.29	−0.25	0.00	−0.25	−0.47	−1.7	−2.2
	16	Berlin	406 B. Tauri	I	−0.96	−0.77	−0.14	−0.48	−0.50	−0.15	+0.02	−0.47	−0.44	+0.5	0.0
	16	Berlin	136 Tauri	I	−0.29	−0.23	+0.28	+0.92	+0.97	−0.05	0.00	+0.97	−0.13	−0.4	−0.5
	16	Berlin	136 Tauri	EB	+0.17	+0.14	+0.29	+0.94	+0.99	+0.02	0.00	+0.98	+0.08	−2.7	−2.7
	20	Washington	α Leonis	E	+0.67	+0.05	+0.74	+0.15	+0.76	−0.22	+0.34	+0.37	−0.18	+4.0	+4.1
Feb.	15	Cape	γ Cancri	I	−0.30	−0.12	+0.82	+0.50	+0.96	−0.33	−0.03	+0.75	−0.11	0.0	−0.1
Mar.	15	Berlin	α Leonis	I	−0.96	−0.15	−0.29	−0.05	−0.30	+0.01	−0.41	−0.11	−0.49	+0.6	+0.1
	15	Berlin	α Leonis	EB	+0.86	+0.14	−0.50	−0.07	−0.51	+0.30	+0.32	−0.31	+0.44	−0.8	−0.7
	23	Cape	α Scorpii	E	+0.81	−0.90	+0.01	+0.44	−0.44	+0.09	+0.14	+0.41	−0.84	−1.3	−1.2
Apr.	11	Cracow	ν Leonis	I	−0.73	−0.19	+0.67	+0.11	+0.68	−0.35	−0.24	+0.42	−0.64	−0.4	−0.7
	11	Berlin	ν Leonis	I	−0.65	−0.17	+0.75	+0.12	+0.76	−0.37	−0.20	+0.46	−0.58	+0.5	+0.2
	16	Berlin	85 Virginis	IB	−0.85	+0.68	−0.24	+0.33	−0.41	+0.13	−0.39	+0.23	−0.02	−2.4	−2.8
	19	Washington	τ Scorpii	IB	−0.50	+0.56	−0.08	−0.82	+0.83	−0.08	−0.06	−0.74	+0.39	−3.3	−3.5
	19	Washington	τ Scorpii	E	+0.51	−0.57	−0.08	+0.82	−0.11	+0.08	−0.79	−0.39	−0.39	+2.1	+2.1
May	6	Washington	μ Cancri	I	−0.86	−0.59	+0.48	+0.35	+0.59	−0.26	−0.18	+0.56	−0.74	−0.1	−0.5
	8	Berlin	ψ Leonis	I	−1.01	−0.41	−0.03	−0.01	−0.03	−0.12	−0.38	+0.03	−1.00	+0.4	0.0
	9	Cape	ρ Leonis	I	−0.94	−0.16	+0.29	−0.01	+0.29	−0.23	−0.39	+0.17	−0.95	+0.2	−0.2
	18	Cape	3 Sagittarii	E	+0.86	−0.92	+0.10	+0.25	−0.27	+0.02	0.00	+0.24	−0.46	−1.2	−1.2
	19	Cape	φ Sagittarii	IB	−0.90	+0.86	+0.05	+0.07	−0.09	−0.04	+0.11	+0.08	+0.69	−1.7	−2.1
	19	Cape	φ Sagittarii	E	+0.90	−0.86	+0.04	+0.06	−0.07	+0.02	−0.49	+0.08	−0.69	+1.5	+1.5
	20	Cape	h Sagittarii	IB	−0.91	+0.72	0.00	0.00	0.00	−0.03	+0.21	−0.02	+0.83	−3.3	−3.7
	20	Cape	h Sagittarii	E	+0.90	−0.71	+0.11	+0.11	−0.16	+0.01	−0.22	+0.18	−0.82	−6.6	−6.6
	22	Cape	ι Capricor.	IB	−0.91	+0.28	−0.26	−0.08	+0.27	+0.02	+0.38	−0.18	+0.95	−1.3	−1.7
	22	Cape	ι Capricor.	E	+0.79	−0.24	−0.53	−0.16	+0.55	+0.26	−0.26	−0.40	−0.82	+0.1	+0.1
June	12	Cape	A^1 Scorpii	I	−0.79	+0.85	+0.13	−0.47	+0.47	−0.11	−0.19	−0.34	−0.36	+0.6	+0.3
July	10	Camb., Mass.	τ Scorpii	I	−0.59	+0.62	−0.13	−0.76	+0.77	−0.08	−0.07	−0.69	−0.42	+0.8	+0.6
	10	Washington	τ Scorpii	I	−0.46	+0.51	−0.14	−0.85	+0.86	−0.08	−0.05	−0.77	−0.34	+3.4	+3.2
Sept.	3	Cracow	τ Scorpii	I	−0.87	+0.94	−0.06	−0.25	+0.25	−0.05	−0.12	−0.18	−0.97	+0.3	0.0
	8	Washington	ι Capricor.	I	−0.81	+0.44	+0.53	+0.10	−0.54	−0.24	+0.26	+0.56	−0.41	+1.4	+1.1
Oct.	13	Washington	η Tauri	E	+0.51	+0.40	+0.04	+0.89	+0.89	+0.25	−0.07	+0.73	−0.26	−0.2	−0.2

GROUP X—1839–1856—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1840, Nov. 2	Washington	ι Capricor.	I	−0.82	+0.52	+0.46	+0.06	−0.47	−0.19	+0.29	+0.44	−0.87	+2.5	+2.2
2	Camb., Mass.	ι Capricor.	I	−0.85	+0.54	+0.41	+0.06	−0.41	−0.18	+0.30	+0.27	−0.90	+3.4	+3.1
2	Washington	ι Capricor.	EB	+0.93	−0.59	+0.04	0.00	−0.04	+0.02	−0.38	−0.04	+0.99	−8.2	−8.2
3	Washington	c Aquarii	I	−0.95	+0.39	−0.05	0.00	−0.05	−0.08	+0.40	+0.07	−0.93	+1.9	+1.6
1841, Feb. 7	Berlin	d Leonis	E	+1.00	+0.47	−0.37	+0.16	−0.40	+0.37	+0.36	−0.17	−0.27	−1.7	−1.7
27	Cracow	7 Tauri	I	−0.55	−0.39	−0.13	−0.84	−0.85	−0.25	+0.09	−0.67	−0.52	+1.8	+1.6
Apr. 28	Cracow	π Cancri	I	−0.69	−0.59	+0.76	−0.01	+0.76	−0.27	−0.18	+0.59	−0.64	+0.1	−0.1
May 23	Berlin	ω Geminor.	I	−1.05	−0.94	+0.29	+0.17	+0.33	−0.24	−0.15	+0.39	−0.63	−2.2	−2.5
June 4	Washington	p Sagittarii	E	+0.88	−0.47	−0.18	−0.20	+0.27	0.00	−0.01	−0.30	−0.15	−2.2	−2.3
30	Cape	σ Scorpii	I	−0.87	+0.59	−0.16	−0.30	+0.34	−0.08	−0.11	−0.26	−0.54	+1.6	+1.3
Aug. 1	Washington	19 Capricor.	I	−0.86	+0.92	−0.30	0.00	+0.30	+0.09	+0.35	−0.16	−0.02	+1.6	+1.4
10	Berlin	17 Tauri	IB	−1.04	−0.56	−0.01	−0.03	−0.03	−0.12	+0.17	+0.04	+0.96	−4.0	−4.2
10	Berlin	16 Tauri	IB	−0.78	−0.41	−0.21	−0.63	−0.67	−0.20	+0.21	−0.51	+0.71	−2.7	−2.9
10	Berlin	20 Tauri	IB	−0.74	−0.40	−0.22	−0.66	−0.70	−0.20	+0.12	−0.55	+0.69	+0.2	0.0
10	Berlin	16 Tauri	E	+0.89	+0.48	−0.16	−0.49	−0.52	+0.02	−0.16	−0.50	−0.83	+2.4	+2.3
10	Berlin	17 Tauri	E	+1.03	+0.55	+0.05	+0.14	+0.15	+0.14	−0.17	+0.06	−0.95	+1.1	+0.9
10	Berlin	η Tauri	IB	−0.79	−0.43	+0.21	+0.62	+0.66	+0.02	+0.14	+0.61	+0.73	−1.6	−1.8
10	Berlin	20 Tauri	E	+0.88	+0.47	−0.17	−0.51	−0.54	+0.03	−0.17	−0.50	−0.81	+2.1	+1.9
Sept. 6	Washington	17 Tauri	IB	−0.95	−0.46	+0.12	+0.35	+0.37	−0.03	+0.17	+0.37	+0.90	−4.6	−4.8
6	Washington	q Tauri	IB	−0.66	−0.32	−0.25	−0.72	−0.76	−0.19	+0.10	−0.60	+0.62	−2.5	−2.7
6	Washington	20 Tauri	IB	−0.98	−0.48	−0.09	−0.25	−0.27	−0.13	+0.16	−0.16	+0.93	−3.3	−3.5
6	Washington	17 Tauri	E	+0.78	+0.38	+0.22	+0.61	+0.64	+0.18	−0.13	+0.49	−0.75	+1.2	+1.1
6	Washington	16 Tauri	E	+1.02	+0.50	+0.01	+0.03	+0.03	+0.10	−0.17	−0.04	−0.97	+3.4	+3.2
6	Washington	q Tauri	E	+0.88	+0.44	−0.17	−0.47	−0.50	0.00	−0.16	−0.48	−0.84	+1.8	+1.6
6	Washington	20 Tauri	E	+1.02	+0.50	+0.03	+0.07	+0.07	+0.11	−0.17	−0.01	−0.97	+3.3	+3.1
6	Washington	21 Tauri	E	+0.82	+0.40	−0.21	−0.56	−0.60	−0.03	−0.15	−0.56	−0.79	−9.3	−9.5
6	Washington	22 Tauri	E	+0.91	+0.45	−0.15	−0.42	−0.45	+0.01	−0.17	−0.43	−0.86	+2.4	+2.2
22	Cracow	66 B. Sagittarii	I	−0.59	+0.53	+0.63	+0.44	−0.76	−0.08	+0.05	+0.81	−0.64	−0.6	−0.7
25	Washington	21 Capricor.	I	−0.88	+0.97	+0.19	−0.01	−0.19	−0.06	+0.33	+0.24	−0.78	+1.9	+1.7
Oct. 6	Washington	ε Geminor.	E	+0.77	+0.66	+0.61	+0.32	+0.69	+0.02	+0.09	+0.62	−0.72	+2.4	+2.2
Nov. 27	Washington	17 Tauri	I	−1.06	−0.35	+0.04	+0.09	+0.10	−0.12	+0.18	+0.16	−0.10	−7.5	−7.7
27	Washington	20 Tauri	I	−0.94	−0.32	−0.20	−0.44	−0.49	−0.21	+0.15	−0.34	−0.09	−5.1	−5.3
1842, Jan. 21	Washington	16 Tauri	I	−1.03	−0.29	+0.03	+0.05	+0.06	−0.10	+0.16	+0.13	−0.84	+6.6	+6.4
21	Washington	q Tauri	I	−0.93	−0.26	−0.20	−0.39	−0.43	−0.16	+0.13	−0.29	−0.76	+0.3	+0.1
21	Washington	21 Tauri	I	−0.87	−0.25	−0.25	−0.48	−0.54	−0.17	+0.14	−0.40	−0.71	+0.4	+0.2
21	Washington	22 Tauri	I	−0.94	−0.26	−0.19	−0.36	−0.41	−0.16	+0.15	−0.28	−0.76	+0.6	+0.4
24	Washington	ω Geminor.	I	−0.92	−0.81	−0.12	−0.32	−0.34	−0.01	−0.11	−0.30	−0.29	+7.8	+7.6
Mar. 22	Cracow	o^2 Cancri	I	−1.05	−0.92	−0.30	+0.07	−0.31	−0.09	−0.35	−0.15	−0.68	−3.1	−3.3
22	Cracow	o^1 Cancri	I	−0.87	−0.76	+0.61	−0.14	+0.62	−0.37	−0.23	+0.55	−0.56	−2.5	−2.6
Apr. 12	Camb., Mass.	ε Arietis	I	−0.82	+0.06	+0.20	+0.52	+0.55	+0.08	+0.22	+0.45	−0.43	−1.5	−1.6
May 14	Cracow	63 Geminor.	I	−1.02	−0.77	+0.26	+0.03	+0.26	−0.19	−0.19	+0.32	−0.83	+3.0	+2.9
1843, Jan. 24	Camb., Mass.	σ Scorpii	E	+0.89	+0.76	−0.39	−0.27	+0.48	+0.03	+0.08	−0.52	−0.79	+3.9	+3.5
Mar. 6	Cracow	47 Arietis	I	−0.91	+0.74	−0.02	−0.02	−0.03	0.00	+0.22	+0.07	−0.92	−3.5	−3.5
May 3	Cracow	1 Geminor.	I	−0.95	+0.06	−0.11	−0.01	−0.11	−0.03	−0.10	−0.02	−0.79	−3.0	−3.0
3	Cracow	3 Geminor.	I	−0.74	+0.03	−0.63	−0.05	−0.63	+0.02	−0.07	−0.56	−0.62	−4.2	−4.2
3	Cracow	4 Geminor.	I	−0.91	+0.04	−0.31	−0.02	−0.31	−0.02	−0.08	−0.22	−0.76	−1.3	−1.3
9	Cracow	e Leonis	I	−0.71	−0.62	−0.17	+0.75	−0.77	+0.19	−0.34	−0.03	−0.49	−2.4	−2.4
June 3	Cracow	h Leonis	I	−0.93	−0.61	−0.30	+0.32	−0.44	+0.05	−0.33	−0.20	−0.86	−2.4	−2.4
Sept. 11	Cape	η Piscium	IB	−0.19	+0.21	−0.43	−0.88	−0.98	−0.31	0.00	+0.43	+0.12	+4.1	+4.1
20	Camb., Mass.	39 Sagittarii	I	−0.70	−0.24	+0.69	+0.20	−0.72	−0.18	+0.11	+0.75	−0.70	0.0	0.0
Oct. 6	Berlin	19 Piscium	I	−0.80	+0.74	0.00	−0.49	−0.49	−0.22	+0.31	+0.10	−0.34	+0.7	+0.8
Nov. 2	Cracow	κ Piscium	I	−0.87	+0.71	+0.02	−0.28	−0.28	−0.10	+0.36	+0.13	−0.78	−1.1	−1.0
2	Cracow	9 Piscium	I	−0.85	+0.69	−0.03	+0.35	+0.35	+0.15	+0.41	+0.03	−0.75	−2.2	−2.1
3	Camb., Mass.	45 Piscium	I	−0.90	+0.89	−0.03	−0.14	−0.14	−0.03	+0.36	+0.07	−0.63	−0.2	−0.1
27	Berlin	c^2 Capricor.	I	−0.90	+0.24	−0.18	+0.31	+0.36	+0.06	+0.34	−0.13	−0.87	−2.2	−2.1
1844, Jan. 8	Cape	π Leonis	IB	−1.03	−0.42	+0.01	−0.02	+0.03	−0.13	−0.37	+0.06	+0.69	−3.3	−3.2
8	Cape	π Leonis	E	+1.02	+0.42	−0.05	+0.11	−0.12	+0.16	+0.36	−0.12	−0.68	+1.2	+0.7
31	Cape	2 Geminor.	I	−0.85	+0.50	−0.45	+0.07	−0.45	−0.01	−0.08	−0.48	−0.52	−2.2	−2.1
Feb. 22	Camb., Mass.	104 Piscium	I	−0.86	+0.92	+0.18	+0.24	+0.30	+0.12	+0.29	+0.22	−0.77	+0.6	+0.7
Apr. 26	Cracow	ω Leonis	I	−0.98	−0.12	+0.09	−0.17	+0.19	−0.14	−0.33	+0.22	−0.90	−0.2	−0.1
June 25	Cape	40 H. Virginis	I	−0.40	−0.35	+0.73	+0.58	−0.93	+0.18	−0.15	+0.54	−0.29	−0.2	−0.1
25	Cape	40 H. Virginis	EB	+0.52	+0.45	+0.70	+0.54	−0.88	+0.32	−0.09	+0.46	+0.38	−1.6	−1.9
1845, Jan. 12	Cracow	κ Piscium	I	−0.98	−0.06	−0.08	−0.23	−0.25	−0.17	+0.35	+0.12	−0.77	−0.2	+0.1
12	Cracow	9 Piscium	I	−0.95	−0.05	+0.11	+0.34	+0.36	+0.05	+0.36	+0.01	−0.74	−1.6	−1.3
Mar. 22	Berlin	e Leonis	I	−0.42	−0.02	−0.36	−0.84	+0.92	+0.33	+0.25	+0.16	−0.02	−5.3	−5.2
Apr. 12	Cracow	68 Orionis	I	−0.89	+0.99	−0.10	+0.07	−0.12	+0.02	−0.07	−0.05	−0.93	−2.5	−2.2
May 16	Berlin	e Leonis	I	−0.59	+0.03	−0.35	−0.73	+0.81	−0.33	−0.16	+0.17	−0.48	−0.2	0.0
16	Berlin	e Leonis	EB	+0.76	−0.04	−0.29	−0.58	+0.64	−0.19	+0.31	+0.02	+0.62	+1.3	+0.8
20	Berlin	25 Libræ	I	−0.94	−0.65	−0.54	−0.07	+0.54	−0.25	−0.13	−0.34	−0.10	−1.0	−0.7
20	Cracow	25 Libræ	I	−0.96	−0.66	−0.50	−0.07	+0.51	−0.25	+0.14	−0.31	−0.10	−0.4	−0.1

GROUP X—1839–1856—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	a_0	δ_0	ε	P	n	n'
													″	″
1845, June 16	Berlin	10 Libræ	I	−0.71	−0.44	+0.75	+0.14	−0.76	+0.04	+0.14	+0.58	−0.38	−0.4	−0.1
July 16	Camb., Mass.	58 Ophiuchi	I	−1.09	−0.94	+0.25	−0.15	−0.29	−0.23	+0.05	+0.37	−0.47	−0.2	+0.2
17	Camb., Mass.	29 Sagittarii	I	−1.09	−0.95	−0.22	+0.23	+0.32	−0.19	+0.14	−0.24	−0.26	+1.0	+1.4
Sept. 13	Cracow	c^1 Capricor.	I	−1.09	−0.82	+0.01	+0.13	+0.13	−0.13	+0.31	−0.02	−0.52	−3.3	−2.9
22	Camb., Mass.	57 Orionis	E	+0.83	−0.86	−0.31	+0.23	−0.39	−0.01	+0.03	−0.45	−0.92	+3.1	+2.4
22	Camb., Mass.	64 Orionis	E	+0.89	−0.93	+0.11	+0.09	+0.14	−0.05	+0.05	+0.07	−0.98	+3.8	+3.1
Oct. 20	Berlin	71 Orionis	IB	−0.86	+0.89	−0.23	−0.21	−0.31	+0.03	−0.05	−0.26	+0.82	−5.1	−4.8
20	Berlin	71 Orionis	E	+0.85	−0.91	−0.25	−0.24	−0.34	−0.03	+0.05	−0.28	−0.83	+3.0	+2.3
Nov. 6	Berlin	ν Aquarii	I	−0.43	−0.39	+0.03	−0.91	−0.92	−0.30	+0.08	+0.68	−0.41	+1.6	+1.8
6	Berlin	ν Aquarii	EB	+0.65	+0.58	+0.02	−0.79	−0.79	−0.14	−0.20	+0.53	+0.62	0.0	−0.5
6	Cracow	ν Aquarii	I	−0.73	−0.63	+0.03	−0.73	−0.73	−0.29	+0.16	+0.57	−0.68	+0.4	+0.7
9	Cracow	22 Piscium	I	−1.02	−0.50	−0.05	−0.05	−0.07	−0.11	+0.34	+0.07	−0.84	−1.1	−0.7
9	Berlin	22 Piscium	I	−0.98	−0.46	−0.19	−0.21	−0.28	−0.17	+0.31	+0.07	−0.81	+0.4	+0.8
9	Berlin	22 Piscium	EB	+1.02	+0.47	−0.07	−0.08	−0.11	+0.05	−0.34	−0.05	+0.83	−1.0	−1.8
10	Camb., Mass.	δ Piscium	I	−0.94	−0.26	+0.29	+0.20	+0.35	+0.06	+0.30	+0.12	−0.64	−1.0	−0.6
Dec. 6	Camb., Mass.	22 Piscium	I	−0.96	−0.51	+0.22	+0.24	+0.33	+0.04	+0.35	+0.08	−0.95	−1.4	−1.0
1846, Feb. 6	Camb., Mass.	71 Orionis	I	−0.88	+0.81	+0.15	−0.18	+0.24	−0.01	−0.07	+0.29	−0.73	−1.9	−1.5
20	Camb., Mass.	16 Sagittarii	E	+1.03	+0.85	−0.22	+0.27	+0.35	+0.19	−0.08	−0.41	−0.77	+2.1	+1.3
Mar. 31	Camb., Mass.	97 Tauri	I	−0.84	+0.42	+0.39	−0.26	+0.47	+0.01	+0.05	+0.48	−0.74	−3.6	−3.2
May 3	Camb., Mass.	ω Leonis	I	−0.57	+0.62	+0.17	+0.76	−0.77	+0.22	−0.21	−0.42	−0.62	−1.0	−0.7
4	Cracow	14 Sextantis	I	−0.90	+0.92	+0.07	+0.16	−0.18	+0.08	−0.31	−0.05	−0.93	−2.0	−1.6
June 29	Camb., Mass.	69 Leonis	I	−0.79	+0.73	−0.33	−0.36	+0.49	−0.13	−0.28	+0.19	−0.84	−0.8	−0.4
Aug. 14	Berlin	68 Tauri	E	+0.70	−0.07	+0.56	−0.38	+0.68	+0.07	−0.06	+0.58	−0.72	+3.6	+3.0
Sept. 14	Berlin	68 Geminor.	E	+0.89	−0.73	+0.04	−0.23	+0.23	−0.04	+0.16	+0.23	−0.89	+2.7	+1.9
Nov. 22	Berlin	ρ Sagittarii	I	−1.05	−0.72	−0.03	+0.18	+0.18	−0.12	+0.14	−0.15	−0.73	−1.4	−0.8
1847, Jan. 3	Camb., Mass.	65 Cancri	E	+0.87	−0.72	+0.09	+0.32	−0.33	+0.06	−0.01	−0.25	−0.36	+1.0	+0.2
5	Camb., Mass.	34 Sextantis	E	+0.86	−1.00	−0.22	−0.22	+0.30	−0.14	−0.05	+0.07	−0.82	+0.8	0.0
25	Camb., Mass.	δ Tauri	I	−0.60	−0.16	+0.59	−0.53	+0.80	+0.07	−0.05	+0.73	−0.63	−1.2	−0.8
25	Camb., Mass.	68 Tauri	I	−0.88	−0.17	−0.34	+0.32	−0.47	−0.08	−0.06	−0.40	−0.75	−0.4	+0.1
25	Greenwich	180 B. Tauri	I	−0.75	−0.16	−0.51	+0.42	−0.66	−0.13	+0.10	−0.56	−0.70	+0.8	+1.3
25	Camb., Eng.	180 B. Tauri	I	−0.72	−0.15	−0.54	+0.43	−0.69	−0.12	+0.09	−0.58	−0.76	−0.4	0.0
Feb. 24	Camb., Eng.	u Geminor.	I	−0.75	+0.26	−0.13	+0.58	−0.60	+0.05	−0.06	−0.57	−0.72	−1.9	−1.4
Mar. 24	Greenwich	λ Geminor.	I	−0.64	+0.27	−0.05	+0.73	−0.73	+0.09	−0.09	−0.68	−0.67	−0.5	−0.1
24	Greenwich	λ Geminor.	EB	+0.49	−0.21	−0.06	+0.85	−0.85	+0.09	+0.06	−0.82	+0.52	+0.6	+0.2
26	Greenwich	κ Cancri	I	−0.90	+0.80	+0.02	+0.04	−0.04	+0.06	−0.24	+0.01	−0.81	−0.5	+0.1
Apr. 22	Greenwich	A^2 Cancri	I	−0.93	+0.63	+0.15	+0.42	−0.44	+0.12	−0.21	−0.32	−0.90	+5.3	+5.9
22	Camb., Eng.	A^2 Cancri	I	−0.82	+0.62	+0.15	+0.44	−0.46	+0.12	−0.21	−0.33	−0.87	−1.3	−0.7
25	Cape	d Leonis	I	−0.85	+0.93	+0.28	+0.20	−0.34	+0.13	−0.31	−0.05	−0.70	−2.0	−1.4
May 23	Greenwich	υ Leonis	I	−0.90	+1.00	−0.08	−0.04	+0.09	+0.02	−0.31	+0.05	−0.93	−0.7	0.0
23	Camb., Eng.	υ Leonis	I	−0.89	+1.00	−0.06	−0.03	+0.07	+0.03	−0.31	+0.05	−0.93	−1.0	−0.3
28	Camb., Eng.	ζ Libræ	I	−0.89	+0.41	+0.26	−0.20	−0.33	+0.06	−0.18	+0.29	−0.15	+1.3	+2.0
June 1	Camb., Eng.	ρ Sagittarii	IB	−1.01	−0.45	0.00	−0.19	−0.19	−0.11	+0.12	+0.20	+0.65	−8.7	−7.9
1	Camb., Eng.	ρ Sagittarii	E	+1.01	−0.45	0.00	−0.18	−0.18	+0.06	−0.12	+0.15	−0.65	+1.0	+0.1
1	Greenwich	ρ Sagittarii	E	+1.02	+0.46	0.00	−0.17	−0.17	+0.07	−0.13	+0.14	−0.65	+2.0	+1.1
17	Cape	ο Leonis	I	−0.92	+0.77	−0.05	−0.06	+0.08	0.00	−0.26	+0.11	−0.83	−2.0	−1.3
Sept. 16	Camb., Mass.	29 Ophiuchi	I	−0.90	+0.31	−0.14	+0.28	+0.32	−0.03	+0.03	−0.28	−0.91	−2.0	−1.2
Oct. 18	Cape	ν Aquarii	I	−0.97	−0.61	+0.23	+0.32	+0.39	−0.02	+0.23	−0.17	−0.81	−2.2	−1.3
Nov. 18	Camb., Eng.	44 Piscium	I	−0.65	−0.59	+0.81	+0.03	+0.81	+0.16	+0.23	+0.07	−0.39	−4.3	−3.7
1848, Jan. 12	Camb., Mass.	80 Piscium	I	−1.06	−0.87	−0.13	+0.03	−0.13	−0.15	−0.08	−0.06	−0.87	−2.0	−0.9
16	Greenwich	α Tauri	EB	+0.72	+0.49	+0.31	−0.66	+0.73	+0.17	−0.08	+0.68	+0.53	+1.3	+0.7
16	Camb., Eng.	α Tauri	I	−0.86	−0.58	+0.24	−0.53	+0.58	−0.02	+0.10	+0.52	−0.61	−2.8	−1.9
16	Camb., Eng.	α Tauri	EB	+0.74	+0.50	+0.30	−0.65	+0.71	+0.15	−0.08	+0.67	+0.56	+1.0	+0.3
Feb. 12	Camb., Mass.	α Tauri	I	−0.54	−0.50	+0.37	−0.78	+0.86	+0.06	−0.02	+0.80	−0.63	−1.9	−1.4
12	Camb., Mass.	α Tauri	EB	+0.33	+0.12	+0.40	−0.86	+0.95	+0.15	+0.01	+0.88	+0.16	+0.9	+0.6
15	Cracow	λ Geminor.	I	−0.84	−0.20	−0.13	−0.54	+0.55	−0.09	−0.08	+0.54	−0.60	−2.7	−1.9
Mar. 11	Camb., Mass.	111 Tauri	I	−0.68	−0.48	+0.15	−0.74	+0.74	−0.01	−0.01	+0.71	−0.71	−3.8	−3.1
21	Camb., Eng.	m Virginis	IB	−0.64	+0.75	+0.60	−0.27	−0.66	+0.26	−0.24	+0.29	+0.28	−2.1	−1.4
Apr. 12	Camb., Mass.	ο Leonis	I	−0.94	+0.25	−0.11	−0.09	+0.14	−0.03	+0.06	+0.08	−0.82	−3.9	−2.9
15	Cape	B. A. C. 4019	I	−0.52	+0.45	−0.82	−0.04	+0.82	−0.24	−0.12	+0.82	−0.30	−0.2	+0.3
May 4	Camb., Mass.	α Tauri	I	....	−0.70	+0.24	−0.66	+0.70	−0.05	−0.03	+0.66	−0.30	−2.3	−1.5
7	Greenwich	68 Geminor.	I	−0.62	−0.19	−0.30	−0.74	+0.80	−0.14	−0.07	+0.76	−0.50	+0.2	+0.9
9	Cracow	35 Leonis	I	−0.26	+0.04	+0.72	+0.64	−0.96	+0.20	−0.08	−0.68	−0.26	−0.5	−0.2
17	Cape	γ Libræ	I	−0.86	+0.90	−0.17	+0.24	+0.30	−0.02	−0.17	−0.22	−0.05	−1.5	−0.6
June 6	Greenwich	10 Sextantis	EB	+0.93	−0.22	−0.24	−0.16	+0.29	−0.05	+0.26	−0.12	+0.86	+7.0	+6.2
8	Cape	τ Leonis	I	−0.65	+0.44	−0.70	−0.08	+0.70	−0.20	−0.19	+0.13	−0.71	−1.8	−1.1
13	Camb., Eng.	30 Libræ	I	−0.78	+0.86	+0.26	−0.38	−0.46	+0.16	+0.20	+0.36	−0.47	−0.7	+0.1
July 11	Camb., Eng.	θ Libræ	I	−0.34	+0.02	−0.40	+0.83	+0.92	−0.14	−0.26	−0.78	−0.32	−2.1	−1.7
11	Greenwich	θ Libræ	I	−0.31	+0.02	−0.41	+0.85	+0.94	−0.15	−0.05	−0.79	−0.26	−0.2	+0.1
15	Camb., Eng.	246 B. Sagittarii	I	−0.67	+0.57	+0.30	+0.66	+0.72	+0.06	+0.07	−0.70	−0.01	−0.4	+0.3
Aug. 7	Camb., Mass.	η Libræ	I	−0.72	+0.89	+0.28	−0.52	−0.59	+0.15	+0.05	+0.48	−0.91	−2.3	−1.5

GROUP X—1839–1856—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1848, Aug. 21	Camb., Eng.	γ Tauri	IB	−1.00	+0.48	−0.12	+0.36	−0.38	−0.18	+0.14	−0.36	+0.93	−9.0	−7.9
21	Camb., Eng.	γ Tauri	E	+1.05	−0.50	−0.08	+0.24	−0.25	+0.09	−0.15	−0.21	−0.96	+1.8	+0.9
21	Greenwich	γ Tauri	E	+1.03	−0.50	+0.07	−0.23	−0.24	+0.07	−0.16	−0.19	−0.97	+1.1	+0.2
Sept. 15	Greenwich	ξ^1 Ceti	E	+0.77	+0.66	+0.56	−0.52	+0.77	+0.37	−0.14	+0.42	−0.41	+4.4	+3.7
15	Camb., Mass.	ξ^1 Ceti	E	+1.12	−0.87	+0.06	−0.05	+0.07	+0.19	+0.07	+0.06	+0.54	+1.8	+0.8
Oct. 28	Camb., Mass.	η Libræ	I	−0.74	+0.94	+0.23	−0.52	−0.57	+0.16	+0.04	+0.44	−0.31	−1.3	−0.5
Nov. 9	Camb., Eng.	ξ^1 Ceti	I	−0.72	−0.58	+0.55	+0.56	+0.78	+0.09	+0.20	+0.40	−0.18	−5.1	−4.3
9	Camb., Eng.	ξ^1 Ceti	EB	+0.58	+0.46	+0.61	−0.63	+0.87	+0.34	−0.10	+0.47	+0.17	−5.0	−5.6
Dec. 4	Camb., Eng.	η Piscium	I	−0.62	−0.34	−0.79	+0.10	−0.80	+0.20	−0.23	0.00	−0.52	+7.4	+8.1
1849, Jan. 3	Camb., Eng	ξ^1 Ceti	I	−0.66	−0.56	−0.52	+0.59	−0.79	−0.29	+0.14	−0.44	−0.54	+4.1	+4.9
3	Cracow	64 Ceti	I	−1.07	−0.90	−0.04	+0.04	−0.06	−0.14	+0.28	−0.07	−0.92	−2.9	−1.6
3	Cracow	ξ^2 Ceti	I	−0.99	−0.83	−0.28	+0.29	−0.41	−0.22	+0.22	−0.28	−0.84	−1.7	−0.5
5	Camb., Mass.	γ Tauri	I	−1.11	−0.99	+0.04	−0.17	+0.17	−0.14	−0.02	+0.15	−0.64	−0.7	+0.6
5	Camb., Mass.	γ Tauri	EB	+1.04	+0.83	+0.08	−0.36	+0.37	+0.22	+0.02	+0.33	+0.54	−8.2	−9.2
5	Camb., Mass.	75 Tauri	I	−1.02	−0.81	−0.07	+0.42	−0.43	−0.21	−0.01	−0.41	−0.52	−0.6	+0.6
5	Greenwich	θ^1 Tauri	I	−1.02	−0.90	+0.06	−0.42	+0.42	−0.10	+0.14	+0.36	−0.58	−1.0	+0.2
5	Greenwich	θ^2 Tauri	I	−0.75	−0.66	+0.10	−0.74	+0.75	−0.01	+0.12	+0.66	−0.43	−1.2	−0.3
5	Greenwich	264 B. Tauri	I	−1.06	−0.94	0.00	+0.30	−0.30	−0.20	+0.14	−0.30	−0.61	+1.1	+2.2
5	Greenwich	θ^1 Tauri	EB	+1.08	+0.95	+0.04	−0.28	+0.28	+0.21	−0.14	−0.48	+0.60	−7.4	−8.5
5	Greenwich	269 B. Tauri	I	−1.11	−0.95	−0.02	+0.13	−0.13	−0.19	+0.15	−0.14	−0.63	+6.1	+7.4
6	Camb., Mass.	111 Tauri	I	−1.02	−0.88	−0.02	−0.45	+0.45	−0.13	+0.02	+0.39	−0.46	−2.3	−1.1
Feb. 9	Camb., Mass.	5 Virginis	IB	−0.93	+0.17	−0.34	+0.06	+0.35	−0.15	+0.07	+0.02	+0.35	−4.4	−3.3
13	Cape	ξ Libræ	E	+0.88	−0.88	+0.12	−0.21	−0.24	+0.03	+0.24	+0.18	−0.94	+3.1	+2.2
27	Greenwich	85 Ceti	I	−0.93	−0.79	−0.27	+0.45	−0.52	−0.46	+0.36	−0.48	−0.77	−1.1	0.0
Mar. 2	Camb., Eng.	130 Tauri	I	−0.99	−0.88	+0.08	+0.37	−0.38	−0.13	+0.05	−0.40	−0.85	+3.1	+4.3
3	Camb., Eng.	26 Geminor.	I	−0.95	−0.77	−0.19	−0.37	+0.41	−0.09	−0.01	+0.38	−0.76	−0.6	+0.5
8	Camb., Eng.	82 Leonis	IB	−0.28	+0.03	−0.96	+0.10	+0.96	−0.30	−0.04	+0.18	+0.03	−1.3	−1.0
11	Camb., Mass.	95 Virginis	E	+0.76	−0.44	+0.37	−0.43	−0.57	+0.15	−0.03	+0.32	−0.34	+0.4	−0.4
29	Greenwich	111 Tauri	I	−1.07	−0.98	−0.03	−0.16	+0.16	[illegible]	[illegible]	+0.23	−0.93	−1.6	−0.3
29	Greenwich	111 Tauri	EB	+1.07	+0.98	−0.03	−0.16	+0.16	[illegible]	[illegible]	+0.17	+0.93	−1.6	−2.7
Apr. 5	Cracow	β Virginis	I	−0.94	+0.14	+0.24	−0.06	−0.24	[illegible]	[illegible]	−0.04	−0.42	−1.9	−0.8
6	Cape	γ Virg. (N)	I	−0.91	+0.39	−0.27	+0.14	+0.30	−0.11	−0.28	−0.09	−0.20	+3.1	+4.2
6	Cape	γ Virg. (S)	I	−0.91	+0.39	−0.27	+0.14	+0.30	−0.11	−0.28	−0.09	−0.20	−1.4	−0.3
May 2	Camb., Mass.	5 Virginis	I	−0.95	+0.10	−0.16	+0.04	+0.16	−0.07	+0.08	0.00	−0.66	−1.6	−0.5
July 12	Greenwich	f Piscium	E	+0.71	+0.38	−0.52	+0.50	−0.72	−0.22	−0.35	−0.16	−0.69	+1.0	+0.3
13	Cape	ξ^1 Ceti	E	+0.33	+0.23	+0.53	−0.79	+0.95	+0.26	−0.04	+0.52	−0.30	−3.0	−3.3
16	Camb., Mass.	α Tauri	I	−1.06	−0.84	+0.01	+0.34	−0.34	+0.16	−0.23	−0.36	+0.65	−0.5	+0.8
Sept. 5	Greenwich	ν Piscium	IB	−0.58	−0.29	−0.50	+0.66	−0.83	−0.30	+0.13	−0.36	+0.55	−4.7	−4.0
5	Greenwich	ν Piscium	E	+0.83	+0.42	−0.36	+0.48	−0.60	−0.05	−0.12	−0.25	−0.55	+1.0	+0.2
5	Camb., Eng.	ν Piscium	IB	−0.56	−0.28	−0.50	+0.67	−0.84	−0.31	+0.13	−0.37	+0.41	−2.1	−1.4
5	Camb., Eng.	ν Piscium	E	+0.69	+0.34	−0.45	+0.60	−0.75	−0.17	−0.25	−0.26	−0.43	+2.3	+1.6
8	Camb., Eng.	71 Tauri	E	+0.99	+0.87	+0.03	+0.38	−0.38	+0.05	−0.18	−0.29	−0.91	+0.9	−0.1
8	Camb., Eng.	θ^2 Tauri	IB	−0.42	−0.38	+0.08	+0.92	−0.92	−0.20	+0.05	−0.85	+0.39	−1.5	−1.0
8	Camb., Eng.	81 Tauri	IB	−1.06	−0.94	−0.01	−0.10	+0.10	−0.10	+0.18	+0.06	+0.98	−6.0	−4.7
8	Camb., Eng.	80 Tauri	E	+1.01	+0.88	−0.03	−0.35	+0.35	+0.18	−0.15	+0.37	−0.92	+1.9	+0.9
8	Camb., Eng.	81 Tauri	E	+1.03	+0.90	−0.02	−0.27	+0.27	+0.16	−0.16	+0.29	−0.94	+5.4	+4.3
25	Cape	ρ Sagittarii	I	−0.59	+0.61	−0.55	−0.53	−0.76	−0.03	+0.03	+0.70	−0.62	−0.3	+0.4
25	Cape	ρ Sagittarii	E	+0.77	−0.80	−0.39	−0.37	−0.54	−0.05	−0.06	+0.55	+0.81	−3.9	−4.7
27	Camb., Mass.	29 Capricor.	I	−0.64	+0.57	+0.71	+0.21	+0.74	+0.15	−0.07	−0.54	−0.64	+4.4	+5.2
Oct. 3	Cape	ξ^1 Ceti	E	+0.78	+0.41	+0.34	−0.60	+0.69	+0.30	−0.18	+0.42	−0.26	0.0	−0.8
25	Cracow	73 B. Aquarii	I	−0.84	+0.57	−0.43	−0.09	−0.44	−0.08	+0.18	+0.24	−0.86	+0.5	+1.5
Nov. 22	Camb., Mass.	40 Aquarii	I	−0.90	+0.50	+0.27	0.00	+0.27	+0.07	−0.09	−0.19	−1.00	+3.2	+4.3
23	Cape	λ Aquarii	I	−0.85	+0.30	−0.45	+0.09	−0.45	−0.15	+0.22	+0.15	−0.86	−0.2	+0.9
23	Cape	λ Aquarii	EB	+0.95	−0.34	−0.12	+0.03	−0.12	−0.01	−0.29	+0.05	+0.96	−2.9	−3.9
26	Cape	μ Piscium	I	−0.64	−0.25	−0.44	+0.59	−0.74	−0.24	+0.17	−0.28	−0.41	−1.3	−0.6
29	Camb., Mass.	θ^2 Tauri	I	−1.00	−0.85	−0.06	−0.48	+0.49	−0.09	+0.02	+0.42	+0.01	−4.6	−3.3
29	Camb., Mass.	α Tauri	I	−1.15	−0.78	+0.01	+0.05	−0.05	−0.22	+0.02	−0.09	+0.01	−2.3	−0.8
Dec. 1	Cape	ν Geminor.	E	+0.64	+0.73	+0.40	+0.54	−0.68	−0.06	−0.02	−0.73	−0.28	+1.2	+0.5
1850, Jan. 17	Cape	φ Aquarii	I	−0.77	+0.30	−0.54	+0.20	−0.58	−0.17	+0.22	+0.12	−0.66	−1.2	−0.2
23	Cape	64 Tauri	I	−0.54	−0.43	+0.15	+0.86	−0.87	−0.24	+0.07	−0.78	−0.38	−2.0	−1.3
23	Camb., Mass.	θ^2 Tauri	I	−1.10	−0.86	−0.01	−0.03	+0.04	−0.15	+0.02	+0.01	−0.76	−3.2	−1.8
23	Camb., Mass.	α Tauri	I	−1.02	−0.75	+0.08	+0.36	−0.37	−0.20	+0.01	−0.39	−0.66	−2.6	−1.3
23	Camb., Mass.	α Tauri	EB	+1.08	+0.87	+0.04	+0.19	−0.19	+0.12	−0.02	−0.13	+0.77	+1.3	+0.1
23	Camb., Eng.	γ Tauri	I	−0.63	−0.50	+0.14	+0.80	−0.82	+0.07	−0.13	−0.53	−0.43	−1.0	−0.2
23	Camb., Eng.	γ Tauri	EB	+1.08	+0.87	+0.01	+0.06	−0.06	+0.12	+0.08	−0.23	+0.77	+2.3	+1.1
23	Camb., Eng.	θ^1 Tauri	I	−1.08	−0.86	+0.03	+0.12	−0.12	−0.12	−0.19	+0.18	−0.76	−2.3	−0.9
23	Greenwich	α Tauri	I	−0.62	−0.49	+0.18	+0.81	−0.83	−0.23	+0.08	−0.79	−0.43	−1.8	−1.0
23	Greenwich	α Tauri	EB	+0.49	+0.39	+0.20	+0.86	−0.89	−0.09	−0.09	−0.81	+0.35	+2.0	+1.5
25	Cape	ν Geminor.	I	−1.05	−0.92	+0.24	+0.29	−0.38	−0.20	+0.02	−0.34	−0.46	−2.4	−1.0
25	Cape	ν Geminor.	EB	+1.09	+0.95	+0.19	+0.23	−0.30	+0.20	−0.03	−0.33	+0.47	+1.5	+0.3

GROUP X 1839-1856—Continued

Date.		Place.	Star.		Ph.	λ	κ	w	ι	h	α_0	δ_0	s	P	n	n'
															″	″
1850, Feb.	21	Cape	64	Orionis	I	−0.59	−0.51	−0.49	−0.69	+0.85	−0.04	+0.05	+0.82	−0.46	−2.6	−1.8
	21	Cape		χ^2 Orionis	I	−0.69	−0.61	+0.45	+0.63	−0.77	−0.15	+0.03	−0.70	−0.55	−2.1	−1.2
	26	Camb., Mass.		σ Leonis	I	−1.10	−0.54	+0.10	−0.04	−0.11	−0.13	+0.08	−0.12	+0.07	−3.4	−2.0
Mar.	23	Greenwich		o^1 Cancri	I	−1.09	−0.93	−0.03	−0.01	+0.03	−0.15	−0.18	−0.02	−0.78	−3.1	−1.7
	24	Camb., Mass.	27	Leonis	I	−0.50	−0.60	+0.89	−0.04	−0.89	+0.14	+0.06	−0.53	−0.46	0.0	+0.7
Apr.	15	Cracow	264	B. Tauri	I	−0.80	−0.56	−0.18	−0.65	+0.67	−0.01	+0.15	+0.58	−0.55	−2.0	0.9
	15	Camb., Eng.		α Tauri	EB	+1.07	+0.75	+0.01	+0.04	−0.04	+0.12	−0.18	+0.03	+0.74	+4.8	+3.6
	15	Camb., Mass.		α Tauri	I	−0.87	−0.67	−0.17	−0.57	+0.58	0.00	+0.03	+0.50	−0.59	−1.7	−0.5
	15	Camb., Mass.		α Tauri	EB	+0.73	+0.42	−0.22	−0.70	+0.74	+0.22	−0.02	+0.73	+0.37	+0.7	−0.1
	15	Cracow		α Tauri	I	−1.06	−0.77	+0.01	+0.02	−0.02	−0.13	+0.19	−0.08	−0.74	−2.5	−1.1
	16	Cracow	120	Tauri	I	−0.65	−0.46	+0.42	+0.68	−0.80	−0.14	+0.05	−0.82	−0.52	+0.1	+1.0
	17	Cape		ν Geminor.	I	−0.84	−0.77	−0.42	−0.43	+0.60	−0.08	+0.02	+0.56	−0.75	−0.5	+0.6
	18	Camb., Mass.		g Geminor.	I	−0.83	−0.87	+0.57	+0.30	−0.64	−0.05	−0.07	−0.66	−0.86	0.0	+1.1
	21	Cracow		ρ Leonis	I	−0.64	−0.52	−0.77	+0.18	+0.80	−0.29	−0.13	+0.29	−0.51	−1.0	−0.1
	22	Cracow		σ Leonis	I	−0.97	−0.60	+0.34	−0.18	−0.38	+0.03	−0.31	−0.17	−0.69	−0.9	+0.5
May	19	Camb., Mass.		σ Leonis	I	−0.94	−0.45	−0.38	+0.20	+0.43	−0.23	+0.06	+0.19	−0.64	−2.4	−1.1
	19	Camb., Mass.		σ Leonis	EB	+1.04	+0.66	−0.12	+0.07	+0.14	+0.07	−0.07	+0.11	+0.94	−1.6	−2.8
	28	Camb., Eng.	36	Sagittarii	IB	−0.90	+0.96	−0.02	−0.01	−0.02	+0.03	+0.01	−0.04	+0.53	−2.7	−1.5
	28	Camb., Eng.	36	Sagittarii	E	+0.89	−0.95	−0.12	−0.09	−0.15	−0.03	−0.01	+0.21	−0.52	+0.1	−1.0
June	1	Greenwich	42	Aquarii	E	+0.90	−0.79	+0.12	−0.03	+0.12	0.00	−0.26	+0.01	−0.98	+2.4	+1.3
	13	Camb., Mass.	82	Cancri	I	−1.04	−0.78	−0.34	−0.02	+0.34	−0.22	+0.07	+0.19	−0.58	−3.8	−2.3
	14	Camb., Mass.		α Leonis	I	−1.08	−0.81	−0.11	+0.02	+0.11	−0.18	+0.07	+0.02	−0.77	−2.6	−1.1
	14	Camb., Mass.		α Leonis	EB	+1.08	+0.79	+0.16	−0.03	−0.17	+0.21	+0.12	−0.05	+0.75	+2.1	+0.8
July	21	Camb., Eng.	21	Sagittarii	I	−0.53	+0.50	−0.60	−0.53	−0.80	+0.06	−0.02	+0.76	−0.33	+0.3	+1.0
	21	Camb., Eng.	21	Sagittarii	EB	+0.54	−0.50	−0.60	−0.53	−0.80	+0.01	+0.02	+0.84	+0.28	−2.3	−2.9
	24	Camb., Eng.	21	Capricor.	I	−0.85	+0.95	+0.29	+0.02	+0.29	+0.09	+0.18	−0.29	−0.13	−2.9	−1.7
	30	Cape		ν Piscium	E	+0.91	−0.05	+0.13	−0.31	+0.34	+0.14	−0.29	+0.22	−0.93	−0.5	−1.6
Aug.	2	Camb., Eng.		α Tauri	IB	−1.05	−0.64	−0.09	−0.19	+0.21	−0.09	+0.19	+0.13	+0.82	+0.1	+1.6
	8	Camb., Mass.		α Leonis	I	−0.35	+0.04	−0.93	+0.21	+0.95	−0.30	0.00	+0.49	0.00	−1.5	−1.0
	8	Camb., Mass.		α Leonis	EB	+0.59	+0.72	−0.84	+0.19	+0.86	−0.10	−0.07	+0.48	+0.09	+0.8	+0.1
	14	Cracow		γ Libræ	I	−0.96	+0.21	−0.02	−0.03	−0.03	+0.01	−0.26	+0.06	−0.99	+0.3	+1.6
	14	Greenwich		γ Libræ	I	−0.94	+0.21	−0.03	−0.14	−0.14	+0.03	−0.26	+0.10	−0.98	+0.4	+1.7
	14	Camb., Eng.		γ Libræ	I	−0.97	+0.21	−0.03	−0.19	−0.19	0.00	−0.25	+0.21	−0.98	+0.8	+2.2
	14	Camb., Eng.		γ Libræ	EB	+0.94	−0.21	−0.03	−0.19	−0.19	+0.17	+0.25	+0.21	+0.08	−3.7	−4.8
	27	Camb., Mass.	73	Ceti	IB	−0.93	−0.07	−0.05	+0.31	−0.32	−0.14	−0.02	−0.20	+0.[illegible]	[illegible]	−0.4
	27	Camb., Mass.	73	Ceti	E	+0.98	+0.09	−0.01	+0.10	−0.10	+0.02	+0.01	+0.02	−0.88	+1.[illegible]	−0.2
	30	Camb., Mass.		α Tauri	IB	−0.85	−0.56	−0.24	−0.52	+0.57	+0.02	+0.03	+0.49	+0.89	−0.9	+0.3
	31	Cape		χ^2 Orionis	IB	−0.60	−0.46	−0.59	−0.59	+0.83	−0.03	+0.04	+0.80	+0.52	−1.1	−0.2
Sept.	1	Cape		ζ Geminor.	E	+1.10	−0.93	+0.01	0.00	−0.01	+0.17	+0.01	−0.01	−0.82	+2.4	+1.1
	12	Camb., Eng.	29	Ophiuchi	I	−0.43	+0.23	−0.47	−0.76	−0.89	+0.13	−0.08	+0.84	−0.48	+0.4	+1.0
	30	Cape		δ Cancri	E	+1.06	+0.97	−0.27	−0.03	+0.27	+0.12	+0.17	+0.22	−0.85	+1.3	0.0
Oct.	13	Camb., Mass.	7	Capricor.	I	−0.74	+0.67	−0.55	−0.10	−0.56	−0.04	−0.06	+0.43	−0.67	0.0	+1.1
	14	Camb., Mass.	23	Capricor.	I	−0.65	+0.52	−0.69	+0.0[illegible]	−0.69	−0.11	−0.05	+0.47	−0.49	−0.3	+0.6
	21	Camb., Mass.	87	Ceti	IB	−0.64	−0.02	−0.02	+0.77	−0.77	−0.26	0.00	−0.53	+0.09	−2.7	−1.8
	21	Camb., Mass.	87	Ceti	E	+0.79	+0.04	−0.01	+0.63	−0.63	−0.13	0.00	−0.48	−0.22	−0.1	−1.1
Nov.	17	Cape		ξ^1 Ceti	I	−0.16	+0.03	−0.14	+0.98	−0.99	−0.34	−0.02	−0.52	−0.06	+0.2	+0.4
	17	Cape		ξ^1 Ceti	EB	+0.54	−0.08	−0.11	+0.84	−0.85	−0.23	−0.24	−0.44	+0.19	−0.1	−0.8
	21	Camb., Eng.	64	Orionis	E	+1.02	+0.66	+0.26	+0.21	−0.34	+0.12	+0.08	−0.27	−0.48	+1.3	0.0
	21	Camb., Eng.	68	Orionis	IB	−1.08	−0.69	−0.13	−0.10	+0.16	−0.14	+0.07	+0.08	+0.50	−1.7	−0.1
Dec.	17	Greenwich	75	Tauri	I	−1.07	−0.38	−0.04	−0.08	+0.09	−0.12	+0.22	−0.10	−0.28	−1.3	+0.3
1851, Jan.	15	Greenwich	64	Orionis	I	−1.00	−0.59	+0.35	+0.26	−0.44	−0.20	+0.08	−0.51	−0.33	−1.9	−0.4
	15	Greenwich	68	Orionis	I	−1.07	−0.63	−0.23	−0.18	+0.29	−0.16	+0.07	+0.22	−0.36	−2.2	−0.6
	15	Camb., Eng.	64	Orionis	I	−0.99	−0.59	+0.37	+0.28	+0.46	−0.19	+0.08	−0.53	−0.30	−1.2	+0.3
	15	Cracow	64	Orionis	I	−1.10	−0.63	+0.07	+0.06	−0.09	−0.18	+0.08	−0.16	−0.37	−3.0	−1.4
Mar.	9	Cape	68	Tauri	I	−0.99	−0.24	−0.02	−0.03	+0.03	−0.05	+0.21	+0.01	−1.00	−1.7	−0.2
	13	Cracow		d^1 Cancri	I	−0.88	−0.77	−0.60	−0.02	+0.61	−0.20	−0.08	+0.46	−0.56	−2.6	−1.3
	13	Camb., Eng.		θ Cancri	I	−1.11	−0.92	+0.12	0.00	−0.12	−0.16	−0.15	−0.17	−0.71	−0.8	+0.9
	13	Greenwich		d^1 Cancri	I	−0.16	−0.14	−0.97	−0.21	+0.99	+0.32	+0.13	+0.62	−0.10	+4.9	+5.1
	13	Greenwich		θ Cancri	I	−1.09	−0.91	−0.20	0.00	+0.20	−0.15	+0.15	−0.14	−0.69	+3.6	+5.2
	26	Cape		υ Capricor.	IB	−0.56	+0.55	−0.78	+0.03	−0.78	−0.10	+0.08	+0.59	+0.55	−1.3	−0.5
Apr.	6	Greenwich		m Tauri	I	−0.99	−0.36	−0.14	−0.07	+0.16	−0.05	+0.16	+0.08	−0.91	−4.1	−2.6
	6	Camb., Eng.		m Tauri	I	−0.99	−0.36	−0.08	−0.09	+0.12	−0.04	+0.16	+0.05	−0.92	−2.9	−1.4
	6	Camb., Eng.		m Tauri	EB	+1.01	+0.36	+0.01	+0.01	−0.02	+0.07	−0.16	+0.05	+0.92	+1.1	−0.2
	7	Camb., Eng.		χ^2 Orionis	I	−1.02	−0.56	+0.01	+0.01	−0.01	−0.08	+0.08	−0.08	+0.99	−2.6	−1.1
	18	Cape	24	Scorpii	E	+0.40	−0.03	−0.57	−0.72	−0.92	+0.21	+0.04	+0.89	−0.23	+1.6	+1.1
May	17	Cape		μ Sagittarii	IB	−0.71	+0.24	+0.61	+0.33	+0.69	−0.09	−0.04	−0.64	+0.37	−1.7	−0.6
	17	Cape		μ Sagittarii	E	+0.58	−0.20	+0.71	+0.37	+0.80	−0.02	+0.05	−0.84	−0.31	−0.1	−0.9
	18	Cape	36	Sagittarii	IB	−0.60	+0.30	−0.74	−0.26	−0.79	−0.02	−0.01	+0.74	+0.40	0.0	+0.9
	18	Cape		ξ Sagittarii	IB	−0.39	+0.20	+0.86	+0.30	+0.91	−0.01	0.00	−0.86	+0.26	+0.1	+0.7
	18	Cape		ξ Sagittarii	E	+0.65	−0.32	+0.70	+0.24	+0.74	+0.03	0.00	−0.78	−0.43	+0.3	−0.5

GROUP X—1839–1856—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1851, June 7	Cape	*c* Virginis	I	−0.82	−0.70	+0.29	−0.58	−0.64	+0.12	−0.32	−0.06	−0.74	−0.4	+0.8
17	Cape	ι Capricor.	E	+0.79	−0.46	−0.47	+0.15	−0.50	−0.11	−0.20	+0.38	−0.38	−0.2	−1.2
July 12	Cape	π Sagittarii	I	−0.93	+0.43	+0.20	+0.05	+0.21	−0.02	+0.02	−0.17	−0.20	−3.2	−1.8
21	Camb., Eng.	ξ² Ceti	E	+0.45	−0.26	+0.17	+0.86	−0.88	−0.29	−0.22	−0.46	−0.48	+1.8	+1.2
Aug. 2	Cracow	80 Virginis	I	−1.04	−0.78	−0.02	+0.26	+0.26	−0.23	−0.33	−0.16	−0.88	−1.2	+0.4
8	Cape	ξ Sagittarii	I	−0.81	+0.33	−0.37	−0.09	−0.39	−0.02	−0.01	+0.36	−0.60	−1.3	0.0
8	Cape	ξ Sagittarii	EB	+0.86	−0.33	−0.41	−0.10	−0.42	+0.03	0.00	+0.43	+0.59	+1.9	+0.7
Sept. 4	Cracow	28 Sagittarii	I	−0.94	+0.25	+0.12	+0.03	+0.13	−0.03	−0.01	−0.21	−0.94	−1.0	+0.5
14	Greenwich	μ Ceti	E	+0.85	−0.78	+0.25	+0.32	−0.40	−0.13	−0.33	−0.17	−0.73	+2.6	+1.4
16	Camb., Eng.	μ Ceti	E	+0.84	−0.77	+0.14	+0.39	−0.41	−0.14	−0.32	−0.19	−0.73	+2.1	+0.9
Oct. 2	Camb., Eng.	222 B. Sagittarii	EB	+0.92	−0.30	−0.18	−0.02	−0.18	+0.01	−0.04	+0.25	+0.96	−3.9	−5.2
11	Camb., Eng.	ξ² Ceti	IB	−0.73	+0.55	−0.16	−0.60	+0.62	+0.21	+0.32	+0.27	+0.25	−4.7	−3.5
11	Camb., Eng.	ξ² Ceti	E	+0.67	−0.50	−0.18	−0.67	+0.69	+0.23	−0.21	+0.47	−0.23	+1.6	+0.7
28	Cape	30 G. Sagittarii	I	−0.71	−0.01	+0.67	+0.25	+0.71	−0.12	−0.06	−0.77	−0.68	−1.6	−0.5
Dec. 5	Cracow	μ Ceti	I	−0.79	+0.62	−0.19	−0.50	+0.54	+0.17	+0.32	+0.26	−0.44	−3.4	−2.2
7	Cape	ε Tauri	I	−0.66	+0.19	+0.54	+0.50	−0.74	−0.21	+0.13	−0.63	−0.07	−1.9	−0.8
7	Cape	ε Tauri	EB	+0.88	−0.26	+0.33	+0.30	−0.45	−0.03	−0.22	−0.42	+0.09	+0.7	−0.5
10	Camb., Eng.	63 Geminor.	IB	−0.99	−0.38	+0.31	+0.01	−0.31	−0.10	−0.04	+0.13	+0.49	−5.9	−4.3
10	Camb., Eng.	63 Geminor.	E	+1.01	+0.39	−0.26	−0.01	+0.26	+0.10	+0.04	+0.34	−0.50	0.0	−1.4
31	Cape	ν Piscium	I	−0.84	+0.83	−0.04	−0.39	+0.39	+0.14	+0.38	+0.09	−0.87	0.0	+1.3
1852, Jan. 4	Cracow	*i* Tauri	I	−0.74	+0.17	+0.54	+0.40	−0.66	−0.16	+0.14	−0.69	−0.35	−2.0	+0.8
6	Cracow	*d* Geminor.	I	−0.89	−0.18	+0.48	+0.08	−0.49	−0.10	+0.01	−0.55	−0.04	−1.2	+0.2
Feb. 3	Camb., Eng.	63 Geminor.	I	−1.06	−0.29	−0.03	0.00	+0.03	−0.13	−0.03	−0.07	−0.35	0.0	+1.7
3	Greenwich	63 Geminor.	I	−1.06	−0.29	−0.06	0.00	+0.06	−0.14	−0.04	−0.04	−0.35	−1.6	+0.1
11	Greenwich	30 Libræ	E	+0.72	+0.53	+0.42	+0.58	+0.72	−0.14	+0.26	−0.49	−0.68	+2.4	+1.4
15	Cape	ο Sagittarii	IB	−0.87	−0.02	−0.44	−0.02	−0.44	−0.04	0.00	+0.40	+0.68	−0.8	+0.6
15	Cape	ο Sagittarii	E	+0.70	+0.01	−0.69	−0.03	−0.69	+0.03	−0.01	+0.72	−0.54	+1.6	+0.6
Mar. 9	Cape	ξ Libræ	IB	−0.96	−0.76	−0.24	−0.44	−0.50	−0.01	−0.32	+0.27	+0.66	−0.7	+0.8
9	Cape	ξ Libræ	E	+0.70	+0.55	−0.38	−0.68	−0.77	+0.37	+0.16	+0.59	−0.48	+1.9	+0.9
30	Cracow	98 B. Cancri	I	−0.65	−0.30	−0.73	+0.30	+0.79	−0.18	−0.08	+0.59	−0.52	−0.6	+0.5
30	Cracow	102 B. Cancri	I	−1.02	−0.48	−0.22	+0.09	+0.24	−0.15	−0.13	+0.12	−0.81	−2.5	−0.9
30	Cracow	107 B. Cancri	I	−0.96	−0.46	−0.37	+0.15	+0.40	−0.16	−0.13	+0.26	−0.77	+0.6	+2.1
Apr. 25	Cracow	δ Geminor.	I	−0.36	−0.07	−0.93	+0.08	+0.93	−0.05	−0.02	+0.86	−0.36	−3.1	−2.5
27	Cracow	83 Cancri	I	−0.58	−0.33	−0.69	+0.45	+0.84	−0.23	−0.09	+0.56	−0.52	−1.5	−0.5
28	Cracow	37 Leonis	I	−0.52	−0.36	−0.59	+0.64	+0.87	−0.31	−0.10	+0.42	−0.44	−2.4	−1.6
May 2	Camb., Eng.	94 Virginis	I	−0.97	−0.81	+0.19	+0.49	+0.53	−0.39	−0.28	−0.33	−0.13	−0.2	+1.4
July 4	Camb., Eng.	29 Aquarii	E	+0.87	−0.47	−0.35	+0.24	−0.42	−0.07	−0.28	+0.32	−0.56	−3.5	−4.8
Aug. 25	Cracow	49 Sagittarii	I	−0.97	−0.28	+0.24	−0.05	+0.24	−0.08	+0.03	−0.33	−0.77	−2.5	−0.9
26	Camb., Eng.	36 B. Capricor.	I	−0.70	+0.07	+0.62	−0.33	+0.71	+0.04	+0.12	−0.66	−0.35	−3.7	−2.5
Sept. 18	Cracow	ν Scorpii	I	−1.08	−0.85	+0.10	+0.04	+0.10	−0.20	−0.27	−0.18	−0.87	−2.6	−0.8
23	Cape	η Capricor.	I	−0.62	+0.03	+0.61	−0.46	+0.77	+0.11	+0.16	−0.56	−0.55	−1.6	−0.5
Oct. 24	Cracow	30 Piscium	I	−0.64	+0.48	−0.08	+0.71	−0.71	−0.27	+0.22	−0.34	−0.48	−0.9	+0.2
24	Greenwich	30 Piscium	I	−0.46	+0.37	−0.04	+0.86	−0.86	−0.33	+0.13	+0.35	−0.34	+5.8	+6.6
24	Greenwich	33 Piscium	I	−0.83	+0.66	−0.02	+0.42	−0.42	−0.17	+0.33	+0.19	−0.61	−3.9	−2.5
1853, Jan. 14	Camb., Eng.	30 Piscium	E	+0.59	−0.39	+0.02	−0.78	−0.78	−0.29	−0.32	+0.12	+0.53	−1.4	−2.3
14	Camb., Eng.	33 Piscium	I	−0.91	+0.60	+0.01	+0.26	−0.26	−0.13	+0.36	−0.08	−0.81	−1.1	+0.5
14	Camb., Eng.	33 Piscium	EB	+0.94	−0.62	0.00	−0.01	+0.01	+0.03	−0.40	+0.11	+0.84	−1.9	−3.4
Feb. 17	Camb., Eng.	*n* Tauri	I	−0.65	+0.67	+0.57	+0.07	−0.58	+0.01	+0.13	+0.75	−0.70	+5.4	+6.6
18	Cracow	1 Geminor.	I	−0.88	+0.66	+0.25	−0.01	−0.25	−0.03	+0.08	−0.33	−0.80	−0.9	+0.7
Mar. 26	Camb., Eng.	95 Virginis	IB	−1.13	−0.93	+0.04	+0.05	+0.06	−0.25	−0.39	−0.11	+0.44	−1.8	+0.3
26	Camb., Eng.	95 Virginis	E	+1.10	+0.91	−0.12	−0.16	−0.20	+0.29	+0.38	+0.18	−0.43	+4.0	+2.2
26	Greenwich	κ Virginis	E	+1.12	+0.93	+0.06	+0.08	+0.10	+0.18	+0.41	+0.03	−0.44	+2.3	+0.5
28	Greenwich	β Scorpii	IB	−1.06	−0.95	+0.29	+0.12	+0.32	−0.29	−0.26	−0.36	+0.74	−2.1	−0.1
Apr. 20	Camb., Eng.	ν Virginis	EB	+1.08	+0.56	0.00	−0.05	−0.05	+0.19	+0.39	+0.08	+0.52	+0.9	−0.9
20	Cape	ξ Virginis	I	−0.40	−0.21	+0.02	−0.93	−0.93	+0.29	−0.23	−0.18	−0.20	−0.4	+0.4
May 12	Cracow	42 Geminor.	I	−0.80	+0.54	+0.44	−0.18	−0.48	0.00	−0.01	−0.67	−0.74	−0.6	+0.9
20	Cracow	95 Virginis	I	−0.94	−0.81	−0.36	−0.44	−0.57	+0.03	−0.38	+0.23	−0.36	−4.0	−2.2
20	Camb., Eng.	95 Virginis	I	−1.11	+0.89	−0.12	−0.14	−0.18	−0.15	−0.41	0.00	−0.43	−4.2	−2.1
20	Camb., Eng.	95 Virginis	EB	+1.01	+0.81	−0.30	−0.34	−0.45	+0.38	+0.32	+0.30	+0.37	+1.5	−0.2
20	Greenwich	95 Virginis	I	−1.12	−0.90	−0.10	−0.11	−0.15	−0.16	+0.41	−0.01	−0.43	−6.3	−4.2
22	Greenwich	β Scorpii	E	+1.03	+0.88	−0.45	−0.16	−0.48	+0.37	+0.23	+0.49	+0.02	−1.5	−3.3
July 17	Cracow	157 B. Ophiuchi	I	−1.10	−0.96	+0.19	0.00	+0.19	−0.25	−0.17	−0.27	−0.60	−2.5	−0.3
Aug. 29	Greenwich	48 Geminor.	E	+0.92	−0.79	−0.02	+0.01	+0.02	+0.01	+0.03	+0.11	−0.76	+2.4	+0.8
Sept. 6	Cape	88 Virginis	I	−1.02	−0.70	−0.21	−0.24	−0.32	−0.04	−0.42	+0.05	−0.63	−3.6	−1.6
8	Cape	174 B. Libræ	I	−0.07	−0.86	+0.42	+0.15	+0.45	−0.30	−0.25	−0.45	−0.82	−1.1	+0.8
11	Cape	1[illegible]0 B. Sagittarii	I	−0.83	−0.70	+0.57	−0.25	+0.62	−0.14	−0.01	−0.68	−0.75	−0.8	+0.9
20	Greenwich	38 Arietis	E	+0.84	−0.76	−0.34	−0.22	+0.41	+0.16	−0.31	+0.34	−0.56	+0.2	−1.3
20	Camb., Eng.	38 Arietis	IB	−0.92	+0.83	−0.08	−0.05	+0.09	+0.02	+0.39	−0.04	+0.60	−2.2	−0.4
Oct. 14	Greenwich	33 Piscium	I	−0.92	+0.12	−0.10	−0.34	+0.35	+0.07	+0.43	+0.11	−0.51	−3.3	−1.5
Dec. 8	Cape	54 B. Ceti	I	−0.40	+0.04	−0.35	−0.84	+0.91	+0.36	+0.18	+0.01	−0.42	−1.8	−1.0

n	n'
″	″
−0.4	+0.8
−0.2	−1.2
−3.2	−1.8
+1.8	+1.2
−1.2	+0.4
−1.3	0.0
+1.9	+0.7
−1.0	+0.5
+2.6	+1.4
+2.1	+0.9
−3.9	−5.2
−4.7	−3.5
+1.6	+0.7
−1.6	−0.5
−3.4	−2.2
−1.9	−0.8
+0.7	−0.5
−5.9	−4.3
0.0	−1.4
0.0	+1.3
−2.0	+0.8
−1.2	+0.2
0.0	+1.7
−1.6	+0.1
+2.4	+1.4
−0.8	+0.6
+1.6	+0.6
−0.7	+0.8
+1.9	+0.9
−0.6	+0.5
−2.5	−0.9
+0.6	+2.1
−3.1	−2.5
−1.5	−0.5
−2.4	−1.6
−0.2	+1.4
−3.5	−4.8
−2.5	−0.9
−3.7	−2.5
−2.6	−0.8
−1.6	−0.5
−0.9	+0.2
+5.8	+6.6
−3.9	−2.5
−1.4	−2.3
−1.1	+0.5
−1.9	−3.4
+5.4	+6.6
−0.9	+0.7
−1.8	+0.3
+4.0	+2.2
+2.3	+0.5
−2.1	−0.1
+0.9	−0.9
−0.4	+0.4
−0.6	+0.9
−4.0	−2.2
−4.2	−2.1
+1.5	−0.2
−6.3	−4.2
−1.5	−3.3
−2.5	−0.3
+2.4	+0.8
−3.6	−1.6
−1.1	+0.8
−0.8	+0.9
+0.2	−1.3
−2.2	−0.4
−3.3	−1.5
−1.8	−1.0

GROUP X—1839-1856—Continued.

Date.	Place.	Star.	Ph.	λ	κ	ϑ	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1853, Dec. 9	Camb., Eng.	33 Ceti	I	−0.08	+0.03	+0.60	+0.80	−1.00	−0.43	−0.06	−0.26	−0.03	+0.5	+0.7
1854, Jan. 7	Cracow	ξ Arietis	I	−0.86	+0.64	−0.30	−0.20	+0.36	+0.13	−0.39	+0.12	−0.90	−3.9	−2.0
Feb. 7	Camb., Eng.	121 Tauri	I	−0.87	+0.97	−0.23	+0.06	+0.24	+0.04	−0.13	+0.17	−0.85	−2.0	−0.2
9	Camb., Eng.	52 Geminor.	I	−0.80	+0.84	−0.37	+0.29	+0.47	−0.02	−0.04	+0.82	−0.51	0.0	+1.7
9	Camb., Eng.	52 Geminor.	EB	+0.83	−0.86	−0.33	+0.26	+0.42	−0.01	+0.04	+0.47	+0.49	−1.6	−3.2
Mar. 3	Cracow	31 Arietis	I	−0.85	+0.54	−0.39	−0.20	+0.44	+0.13	+0.39	+0.18	−0.71	−2.7	−0.8
7	Cape	139 Tauri	I	−0.26	+0.29	−0.89	+0.36	+0.96	+0.08	+0.04	+0.93	−0.28	−0.5	+0.1
7	Cape	139 Tauri	EB	+0.39	−0.44	−0.83	+0.35	+0.90	+0.08	−0.04	+0.93	+0.43	−3.1	−3.9
12	Camb., Eng.	42 Leonis	I	−0.77	+0.37	−0.04	+0.60	+0.60	−0.25	−0.24	+0.24	−0.25	−1.0	+0.7
12	Camb., Eng.	167 B. Leonis	I	−0.96	+0.45	+0.01	−0.22	−0.22	−0.01	−0.36	−0.18	−0.30	−0.9	+1.2
20	Cape	b Ophiuchi	E	+1.07	+0.98	−0.08	+0.02	−0.09	+0.19	+0.15	+0.09	−0.99	+3.0	+0.9
22	Cape	h Sagittarii	IB	−1.06	−0.95	−0.10	+0.10	−0.14	−0.18	+0.08	+0.09	+0.94	−1.6	+0.6
22	Cape	h Sagittarii	E	+0.97	+0.87	−0.31	+0.30	−0.43	+0.13	−0.08	+0.44	−0.86	+1.9	0.0
Apr. 4	Camb., Eng.	ε Geminor.	I	−0.16	+0.18	−0.81	+0.55	+0.98	+0.01	0.00	+0.98	−0.25	−1.8	−1.5
13	Cape	κ Virginis	IB	−0.81	−0.41	+0.56	+0.34	+0.66	−0.41	−0.24	−0.36	+0.18	−2.8	−1.0
13	Cape	κ Virginis	E	+1.04	+0.52	+0.23	+0.14	+0.27	+0.08	+0.42	−0.11	−0.23	+1.4	−0.7
15	Cape	ω¹ Scorpii	E	+0.79	+0.63	+0.69	+0.02	+0.69	−0.03	+0.24	−0.65	−0.46	+3.0	+1.4
May 6	Greenwich	i Leonis	I	−0.70	+0.43	+0.03	+0.67	+0.67	−0.28	−0.23	+0.27	−0.68	−2.7	−1.1
9	Camb., Eng.	48 Virginis	I	−0.96	−0.20	+0.27	+0.28	+0.39	−0.31	−0.37	−0.15	−0.42	−1.0	+1.2
9	Camb., Eng.	48 Virginis	EB	+1.02	+0.22	+0.14	+0.15	+0.20	+0.05	+0.45	+0.01	+0.47	−0.1	−2.2
11	Cape	6 B. Libræ	I	−0.96	−0.55	−0.43	−0.19	−0.47	+0.01	−0.39	+0.21	−0.07	−3.2	−1.0
11	Cape	μ Libræ	I	−0.92	−0.51	−0.52	−0.18	−0.55	+0.02	−0.36	+0.30	−0.07	−2.8	−0.7
11	Cape	μ Libræ	EB	+0.86	+0.48	−0.60	−0.20	−0.63	+0.40	+0.24	+0.47	+0.06	−8.5	−10.3
22	Cape	μ Piscium	IB	−0.91	+0.09	+0.24	+0.21	−0.32	−0.21	+0.38	−0.15	+0.68	−1.7	+0.4
June 7	Cape	κ Virginis	I	−1.04	−0.47	−0.20	−0.11	−0.22	−0.08	−0.44	+0.07	−0.60	−1.7	+0.7
7	Cape	κ Virginis	EB	+0.94	+0.42	+0.42	+0.22	+0.48	+0.03	+0.41	−0.22	+0.55	+3.5	+1.5
14	Cape	κ Capricor.	IB	−0.98	−0.74	−0.09	+0.44	−0.45	+0.31	+0.24	+0.22	+0.69	−1.5	+0.8
14	Cape	κ Capricor.	E	+0.89	+0.67	−0.11	+0.57	−0.58	0.00	−0.28	+0.45	−0.69	+1.8	−0.1
28	Cape	ζ Cancri	I	−0.78	+0.74	+0.15	−0.48	−0.50	+0.11	−0.24	−0.44	−0.54	+1.9	+3.7
28	Cape	79 Cancri	I	−0.55	+0.53	+0.24	−0.76	−0.79	+0.18	−0.18	−0.64	−0.38	+1.2	+2.5
July 5	Cape	μ Libræ	I	−0.48	−0.27	−0.86	−0.25	−0.89	+0.25	−0.25	+0.56	−0.36	−1.0	+0.1
7	Cracow	18 Ophiuchi	I	−0.96	−0.74	+0.47	−0.12	+0.49	−0.31	−0.18	−0.56	−0.45	−4.3	−2.0
13	Cape	ψ³ Aquarii	E	+0.79	+0.43	−0.19	−0.65	+0.68	+0.41	−0.22	−0.12	−0.53	+1.7	0.0
31	Cracow	m Virginis	I	−0.74	−0.18	+0.57	+0.36	+0.67	−0.35	−0.25	−0.32	−0.73	−0.8	+0.9
Sept. 2	Cape	201 B. Sagittarii	I	−0.96	−0.87	−0.33	+0.38	−0.50	−0.22	+0.04	+0.43	−0.70	−3.3	−1.1
2	Cape	201 B. Sagittarii	EB	+1.08	+0.97	−0.15	+0.17	−0.22	+0.21	−0.05	+0.25	+0.79	−6.6	−8.9
4	Camb., Eng.	35 Capricor.	I	−1.[illegible]1	−0.90	+0.02	−0.13	+0.13	−0.19	+0.30	−0.17	−0.49	−2.6	0.0
4	Camb., Eng.	35 Capricor.	EB	+1.04	+0.85	+0.06	−0.37	+0.37	+0.32	−0.26	−0.19	+0.46	−3.6	−5.8
19	Greenwich	i Leonis	E	+0.93	−0.73	+0.01	+0.06	+0.06	+0.02	+0.38	+0.08	−0.39	+2.8	+0.8
30	Greenwich	ω Sagittarii	I	−1.06	−0.98	−0.09	+0.16	−0.18	−0.20	+0.13	+0.09	−0.94	−3.9	−1.4
30	Greenwich	ω Sagittarii	EB	+1.08	−1.00	−0.05	+0.09	−0.10	+0.18	−0.14	+0.17	+0.96	−1.0	−3.3
30	Greenwich	A Sagittarii	I	−1.08	−1.00	−0.02	+0.04	−0.04	−0.19	+0.14	−0.04	−0.96	−4.2	−1.7
30	Camb., Eng.	ω Sagittarii	I	−1.05	−0.98	−0.09	+0.16	−0.18	−0.20	+0.13	+0.09	−0.95	−3.1	−0.6
30	Camb., Eng.	A Sagittarii	I	−1.08	−1.00	−0.02	+0.04	−0.05	−0.20	+0.14	−0.03	−0.96	−2.7	−0.1
30	Cracow	ω Sagittarii	I	−1.08	−1.00	0.00	+0.01	−0.01	−0.20	+0.11	−0.08	−0.96	−4.6	−2.0
30	Cracow	A Sagittarii	I	−1.04	−0.95	+0.16	−0.28	+0.32	−0.16	+0.13	−0.37	−0.91	−2.4	+0.1
Oct 11	Greenwich	139 Tauri	E	+0.85	−0.81	−0.30	+0.19	+0.36	+0.05	−0.08	+0.4	−0.84	+1.8	−0.1
29	Cape	κ Capricor	I	−1.05	−0.92	−0.01	+0.15	−0.15	−0.22	+0.30	+0.02	−0.98	−4.9	−2.4
Nov. 27	Cape	ψ² Aquarii	I	−1.04	−0.78	−0.03	−0.07	+0.07	−0.13	+0.42	−0.08	−1.00	−2.6	0.0
27	Cape	ψ² Aquarii	EB	+0.95	+0.71	−0.10	−0.40	+0.41	+0.31	−0.34	−0.05	+0.91	−0.3	−2.5
Dec. 10	Greenwich	i Leonis	E	+0.87	−0.79	−0.05	−0.23	−0.24	+0.09	+0.35	−0.04	−0.94	+1.7	−0.3
1855, Jan. 3	Cape	υ Geminor.	E	+0.86	−0.92	+0.16	−0.27	−0.31	+0.05	+0.09	−0.29	−0.09	+3.7	+1.7
Mar 23	Camb., Eng.	k Tauri	I	−0.77	+0.42	+0.52	−0.28	−0.59	−0.15	+0.14	−0.55	−0.72	−1.9	+0.1
Apr. 4	Cape	8 Libræ	E	+0.90	+0.08	−0.43	−0.01	−0.43	+0.17	+0.31	+0.32	−0.51	+1.9	−0.3
4	Cape	α Libræ	IB	−0.99	−0.09	+0.06	0.00	+0.06	−0.14	−0.37	−0.03	+0.57	−3.9	−1.2
4	Cape	α Libræ	E	+0.91	+0.08	−0.39	−0.01	−0.39	+0.25	+0.32	+0.29	−0.52	+2.4	+0.1
7	Greenwich	X Sagittarii	E	+1.00	+0.71	−0.16	+0.15	−0.22	+0.16	+0.10	+0.28	−0.93	+3.6	+1.1
8	Cape	φ Sagittarii	IB	−0.96	−0.78	−0.24	+0.32	−0.41	−0.16	0.00	+0.37	+0.90	−2.5	+0.1
8	Cape	φ Sagittarii	E	+0.79	+0.65	−0.39	+0.53	−0.66	+0.12	−0.02	+0.70	−0.75	+1.2	−0.8
23	Greenwich	λ Cancri	I	−0.81	+0.86	−0.10	+0.43	+0.44	−0.09	−0.17	+0.33	−0.90	−3.5	−1.3
23	Camb., Eng.	λ Cancri	EB	+0.90	−0.95	−0.04	+0.16	+0.16	−0.01	+0.21	+0.19	+0.98	−2.4	−4.6
May 8	Cape	ε Capricor.	IB	−0.79	−0.74	+0.05	+0.67	−0.67	−0.34	+0.20	+0.37	+0.74	−3.4	−1.2
June 27	Camb., Eng.	22 Scorpii	EB	+1.04	+0.34	+0.20	−0.10	+0.22	+0.13	+0.25	−0.15	+0.39	−7.1	−9.7
Aug. 30	Camb., Eng.	o Piscium	IB	−1.09	−0.82	+0.07	+0.01	−0.07	−0.24	+0.44	−0.09	+0.63	−1.6	+1.5
30	Greenwich	o Piscium	IB	−1.08	−0.82	+0.06	+0.01	−0.06	−0.22	+0.43	−0.08	+0.64	−2.0	+1.1
30	Greenwich	o Piscium	E	+1.05	+0.80	−0.25	−0.05	+0.25	+0.30	−0.40	+0.17	−0.62	+2.9	+0.1
Sept. 20	Camb., Eng.	234 B. Sagittarii	I	−0.88	−0.66	−0.18	+0.51	−0.54	−0.19	+0.08	+0.45	−0.79	−3.4	−0.8
21	Camb., Eng.	40 B. Capricor.	I	−0.96	−0.79	+0.02	+0.48	−0.48	−0.29	+0.19	+0.35	−0.81	−4.3	−1.5
Oct. 24	Camb., Eng.	o Piscium	I	−0.91	−0.57	−0.57	−0.08	+0.58	+0.07	+0.43	+0.20	−0.17	−1.6	+1.1
24	Greenwich	o Piscium	I	−0.89	−0.56	−0.58	−0.08	+0.59	+0.08	+0.42	+0.21	−0.16	−5.2	−2.5

GROUP X—1839–1856—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1855, Nov. 15	Camb., Eng.	86 B. Capricor.	I	−1.01	−0.88	+0.03	+0.27	−0.27	−0.23	+0.25	+0.16	−0.95	−2.2	+0.8
1856, Jan. 12	Greenwich	29 Piscium	I	−0.41	−0.38	+0.80	+0.48	−0.93	−0.51	+0.07	+0.03	−0.34	−0.6	+0.7
Mar. 11	Camb., Eng.	33 Tauri	I	−0.93	−0.43	+0.38	+0.24	−0.45	−0.26	+0.23	−0.42	−0.77	−1.9	+1.1
13	Camb., Eng.	136 Tauri	I	−0.98	−0.05	−0.02	+0.03	+0.03	−0.09	+0.07	0.00	−1.00	−3.9	−0.8
13	Greenwich	136 Tauri	I	−0.98	−0.05	+0.04	−0.06	−0.07	−0.10	−0.07	−0.04	−1.00	−4.9	−1.8
26	Greenwich	α Scorpii	IB	−0.91	+0.18	+0.20	−0.18	+0.27	−0.12	−0.23	−0.28	+0.89	−1.2	+1.7
26	Camb., Eng.	α Scorpii	I	−0.90	+0.18	+0.20	−0.17	+0.26	−0.11	−0.22	−0.27	+0.88	−1.7	+1.2
Apr. 25	Cape	τ Sagittarii	IB	−1.00	+0.37	−0.01	+0.06	−0.06	−0.14	+0.08	+0.03	+0.96	−6.9	−3.6
25	Cape	τ Sagittarii	E	+1.00	−0.37	+0.01	−0.03	+0.03	+0.13	−0.01	−0.02	−0.96	+5.5	+2.4
June 16	Camb., Eng.	α Scorpii	I	−0.96	+0.34	+0.10	−0.09	+0.13	−0.12	−0.22	−0.14	−0.23	−1.9	+1.4
July 25	Camb., Eng.	63 Arietis	IB	−0.12	−0.08	+0.84	−0.52	−0.99	−0.34	−0.02	−0.79	−0.29	+3.8	+4.2
Sept. 8	Cape	38 B. Sagittarii	I	−0.86	+0.08	+0.14	−0.46	+0.48	−0.11	−0.02	−0.51	−0.84	−3.7	−0.6
20	Greenwich	136 Tauri	IB	−0.44	−0.19	−0.31	+0.85	+0.90	0.00	+0.03	+0.89	+0.43	+2.8	+4.4
20	Camb., Eng.	136 Tauri	IB	−0.49	−0.22	−0.30	+0.82	+0.87	−0.01	+0.03	+0.86	+0.50	−1.0	+0.8
20	Camb., Eng.	136 Tauri	E	+0.26	+0.11	−0.33	+0.91	+0.97	+0.08	−0.01	+0.97	−0.22	+1.1	+0.2
Nov. 11	Camb., Eng.	40 Arietis	I	−0.87	−0.70	+0.57	−0.32	−0.65	−0.43	+0.24	−0.46	−0.11	−0.8	+2.5
12	Cape	η Tauri	IB	−1.12	−0.82	−0.08	+0.08	+0.11	−0.22	−0.30	+0.12	+0.05	−5.1	−1.0

GROUP XI—1857–1873.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
1857, Jan. 15	Cape	η Virginis	IB	−0.72	+0.72	−0.60	−0.08	−0.61	+0.26	−0.46	+0.01	+0.73	−4.4	−1.7
15	Cape	η Virginis	E	+0.42	−0.80	−0.88	−0.11	−0.89	+0.44	+0.10	+0.06	−0.81	+3.4	+1.9
Feb. 6	Cape	φ Geminor.	IB	−0.87	−0.15	−0.13	−0.49	−0.51	−0.03	−0.19	−0.47	−0.41	−3.6	−0.2
Mar. 4	Camb., Eng.	49 Aurigæ	E	+1.01	+0.51	0.00	−0.11	−0.11	+0.14	+0.05	−0.11	+0.95	0.0	−3.7
16	Cape	σ Scorpii	IB	−0.85	+0.74	−0.18	+0.29	−0.35	+0.05	−0.23	+0.31	+0.91	−4.0	−0.7
16	Cape	σ Scorpii	E	+0.63	−0.55	−0.37	+0.61	−0.71	+0.17	+0.13	+0.68	−0.68	+1.5	−0.9
16	Cape	α Scorpii	IB	−0.91	+0.79	−0.04	+0.07	−0.08	−0.03	−0.21	+0.10	+1.00	−4.1	−0.5
18	Cape	38 B. Sagittarii	I	+0.01	0.00	−0.13	+0.99	−1.00	+0.01	0.00	+1.00	0.00	+8.5	+8.5
18	Cape	38 B. Sagittarii	E	+0.34	−0.17	+0.12	−0.92	+0.93	+0.01	+0.01	−0.93	−0.35	+2.5	+1.2
19	Cape	τ Sagittarii	E	+0.63	−0.17	−0.07	−0.76	+0.76	+0.14	−0.07	−0.78	−0.60	+3.0	+0.6
31	Cape	κ Aurigæ	I	−0.88	−0.54	+0.04	−0.54	−0.54	−0.15	0.00	−0.50	−0.81	−2.6	+0.9
Apr. 2	Camb., Eng.	λ Cancri	I	−0.92	−0.21	−0.16	−0.34	−0.37	−0.02	−0.25	−0.32	−0.92	−2.5	+1.2
2	Camb., Eng.	λ Cancri	EB	+0.77	+0.18	−0.26	−0.56	−0.62	+0.23	+0.18	−0.53	+0.74	−0.9	−3.8
2	Greenwich	λ Cancri	I	−0.93	−0.22	−0.14	−0.31	−0.34	−0.03	−0.25	−0.30	−0.92	−3.5	+0.3
29	Cape	φ Geminor.	I	−1.01	−0.37	−0.05	−0.15	−0.16	−0.13	−0.21	−0.17	−0.92	−4.2	−0.1
May 6	Greenwich	α Virginis	I	−0.92	+0.84	+0.44	−0.13	+0.46	−0.32	−0.45	−0.23	−0.38	−2.9	+0.9
6	Greenwich	α Virginis	EB	+0.82	−0.87	+0.36	−0.11	+0.37	−0.16	+0.46	−0.14	+0.40	+1.6	−1.5
6	Camb., Eng.	α Virginis	EB	+0.85	−0.88	+0.32	−0.08	+0.33	−0.13	+0.46	−0.13	+0.42	+2.6	−0.7
27	Greenwich	γ Cancri	I	−0.40	−0.07	+0.50	+0.77	+0.92	−0.31	−0.08	+0.54	−0.31	+0.5	+2.1
31	Cape	β Virginis	I	−0.45	+0.30	+0.87	+0.11	+0.87	−0.44	−0.13	+0.08	−0.47	−3.5	−1.7
July 27	Cape	α Virginis	I	−0.71	+0.68	+0.58	−0.24	+0.63	−0.31	−0.27	−0.27	+0.75	−4.1	−1.1
Sept. 29	Leiden	128 B. Capricor.	I	−0.66	+0.02	+0.59	+0.49	−0.76	−0.36	+0.19	+0.57	−0.46	−3.7	−0.9
30	Camb., Eng.	50 Aquarii	I	−0.93	−0.18	−0.42	−0.19	+0.46	+0.04	+0.43	−0.22	−0.50	−1.3	+2.6
Oct. 6	Camb., Eng.	27 Tauri	IB	−0.73	−0.65	+0.36	−0.67	−0.76	−0.34	+0.15	−0.65	+0.41	−2.1	+1.0
6	Camb., Eng.	27 Tauri	E	+0.89	+0.79	+0.29	−0.55	−0.62	+0.04	−0.24	−0.52	−0.38	−1.3	−4.0
6	Camb., Eng.	28 Tauri	IB	−0.17	−0.15	+0.47	−0.87	−0.99	−0.29	0.00	−0.84	+0.07	−0.2	+0.5
6	Camb., Eng.	28 Tauri	E	+0.40	+0.35	+0.44	−0.83	−0.94	−0.14	−0.13	−0.80	−0.26	+2.0	+0.4
6	Greenwich	27 Tauri	IB	−0.74	−0.66	+0.36	−0.66	−0.75	−0.34	+0.15	−0.64	+0.44	−2.2	+1.0
6	Greenwich	27 Tauri	E	+0.88	+0.79	+0.29	+0.54	−0.61	+0.03	−0.24	−0.51	−0.52	+4.4	+0.8
26	Greenwich	χ Capricor.	I	−0.97	+0.16	0.00	0.00	0.00	−0.09	+0.34	−0.01	−0.97	−4.9	−0.6
28	Greenwich	70 Aquarii	I	−0.84	−0.07	−0.56	−0.16	+0.58	+0.13	+0.43	−0.23	−0.80	−3.3	−0.4
Nov. 23	Cape	γ Capricor.	I	−0.94	+0.07	−0.17	−0.12	+0.21	−0.02	+0.39	−0.15	−0.98	−3.0	+1.2
23	Cape	γ Capricor.	EB	+0.74	−0.54	−0.53	−0.35	+0.64	+0.30	−0.23	−0.42	+0.77	−2.1	−5.2
27	Camb., Eng.	ε Piscium	I	−0.77	−0.55	−0.67	+0.27	+0.72	+0.17	+0.40	+0.19	−0.52	−5.0	−1.6
27	Greenwich	ε Piscium	I	−0.73	−0.51	−0.70	+0.78	+0.75	+0.19	+0.38	+0.20	−0.46	−4.4	−1.2
Dec. 26	Leiden	B.D. +18° 325	I	−0.65	−0.56	+0.53	−0.62	−0.81	−0.42	+0.16	−0.52	−0.45	−1.6	+1.3
1858, Feb. 19	Camb., Eng.	ε Arietis	I	−0.82	−0.71	+0.36	−0.53	−0.64	−0.34	+0.22	−0.45	−0.72	+0.2	+3.9
20	Camb., Eng.	q Tauri	I	−1.06	−0.96	+0.07	−0.18	−0.19	−0.24	+0.26	−0.15	−0.97	−3.9	+0.9
20	Camb., Eng.	q Tauri	EB	+1.07	+0.98	0.00	+0.01	+0.01	+0.19	−0.27	0.00	+1.00	+6.5	+1.9
20	Camb., Eng.	20 Tauri	EB	+0.92	+0.84	−0.20	+0.48	+0.52	+0.29	−0.20	+0.42	+0.84	+4.5	+0.5
20	Greenwich	20 Tauri	I	−0.98	−0.90	−0.15	+0.36	+0.39	−0.08	+0.26	+0.35	−0.92	−3.0	+1.5
Mar. 6	Cape	α Scorpii	IB	−0.88	+0.97	−0.04	+0.20	−0.20	+0.02	−0.18	+0.21	+0.97	−3.7	+0.3
6	Cape	α Scorpii	E	+0.77	−0.85	−0.10	+0.51	−0.52	+0.10	+0.14	+0.50	−0.85	+5.2	+1.8
Apr. 25	Greenwich	28 Virginis	I	−0.05	+0.29	+0.13	−0.05	+0.14	−0.15	−0.45	+0.01	−0.49	−4.6	−0.2
May 18	Greenwich	83 Cancri	I	−0.34	−0.22	−0.84	−0.46	−0.95	+0.27	−0.19	−0.66	−0.30	−1.9	−0.3
18	Camb., Eng.	83 Cancri	I	−0.27	−0.18	−0.85	−0.47	−0.97	+0.30	−0.17	−0.68	−0.31	−0.8	+0.5
19	Camb., Eng.	α Leonis	I	−0.36	−0.18	+0.89	+0.26	+0.93	−0.43	−0.07	+0.51	−0.28	−2.6	−0.9
19	Camb., Eng.	α Leonis	EB	+0.63	+0.30	+0.77	+0.22	+0.80	−0.23	+0.34	+0.40	+0.67	+2.1	−0.7
19	Greenwich	α Leonis	EB	+0.53	+0.26	−0.83	−0.24	−0.86	+0.43	+0.13	−0.48	+0.52	−6.4	−8.8
20	Leiden	56 Leonis	I	−0.62	−0.18	+0.78	+0.05	+0.78	−0.42	−0.20	+0.28	−0.61	−2.9	0.0

GROUP XI—1857–1873—Continued.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	b_0	α_0	δ_0	ε	P	n	n′
													″	″
1858, Aug. 30	Greenwich	q Tauri	IB	−1.06	−0.84	−0.01	+0.06	+0.06	−0.17	+0.25	+0.08	+0.98	−10.8	−5.7
30	Greenwich	q Tauri	E	+0.99	+0.79	−0.08	+0.34	+0.35	+0.25	−0.23	+0.28	−0.92	+5.2	+0.7
30	Greenwich	20 Tauri	IB	−0.80	−0.64	−0.14	+0.64	+0.65	+0.02	+0.22	+0.55	+0.74	−8.9	−5.1
30	Greenwich	16 Tauri	E	+0.65	+0.52	−0.17	+0.76	+0.78	+0.28	−0.14	+0.65	−0.61	+2.6	−0.4
30	Camb., Eng.	16 Tauri	IB	−0.88	−0.70	−0.12	+0.55	+0.56	−0.02	+0.23	+0.49	+0.82	−6.9	−2.7
30	Camb., Eng.	q Tauri	IB	−1.06	−0.84	−0.01	+0.04	+0.04	−0.17	+0.25	+0.06	+0.98	−7.2	−2.1
30	Camb., Eng.	q Tauri	E	+1.00	+0.79	−0.07	+0.32	+0.33	+0.24	−0.22	+0.25	−0.92	+4.2	−0.4
30	Camb., Eng.	20 Tauri	IB	−0.83	−0.66	−0.13	+0.61	−0.62	+0.01	+0.22	+0.54	+0.77	−7.0	−3.0
Sept. 18	Camb., Eng.	17 Capricor.	I	−0.71	+0.62	+0.54	+0.33	−0.63	−0.23	+0.23	+0.53	−0.53	−5.6	−2.2
21	Leiden	82 Aquarii	I	−0.67	+0.20	+0.73	−0.06	−0.73	−0.41	+0.23	+0.25	−0.17	−2.7	+0.5
Oct. 12	Cape	X Sagittarii	I	−0.85	+0.92	+0.12	+0.33	−0.35	−0.02	−0.01	+0.38	−0.85	−4.1	0.0
14	Cape	h Sagittarii	I	−0.90	+0.97	0.00	0.00	+0.01	−0.02	+0.21	−0.02	−1.00	−4.8	−0.5
21	Leiden	210 B. Piscium	I	−0.94	−0.24	−0.32	+0.29	+0.43	+0.06	+0.44	+0.15	−0.11	−2.2	+2.3
Nov. 22	Greenwich	136 Tauri	E	+1.14	+0.96	+0.01	+0.02	+0.02	+0.26	+0.01	−0.03	−0.40	+8.1	+2.8
22	Camb., Eng.	136 Tauri	IB	−1.11	−0.93	−0.08	−0.20	−0.22	−0.25	+0.01	−0.20	+0.39	−6.5	−1.2
22	Camb., Eng.	136 Tauri	E	+1.14	+0.96	−0.01	−0.02	−0.02	+0.25	0.00	−0.05	−0.40	+7.7	+2.4
Dec. 22	Leiden	40 Cancri	E	+0.50	+0.42	+0.80	+0.41	+0.90	−0.15	+0.19	+0.70	−0.22	+3.6	+1.3
22	Leiden	39 Cancri	E	+0.68	+0.58	+0.71	+0.37	+0.80	−0.09	+0.24	+0.61	−0.30	+3.9	+0.7
1859, Jan. 21	Cape	c Leonis	E	+1.07	+0.66	−0.23	+0.05	−0.23	+0.33	+0.42	−0.08	−0.55	+6.2	+1.2
Feb. 8	Cape	η Piscium	I	−0.70	−0.15	+0.40	−0.57	−0.70	−0.36	+0.23	−0.20	−0.68	−1.8	+1.6
11	Cape	φ Tauri	I	−0.25	−0.77	+0.11	+0.97	+0.97	+0.10	+0.05	+0.87	−0.91	+0.4	+1.6
16	Camb., Eng.	ψ Leonis	I	−1.01	−0.78	−0.45	−0.06	−0.45	−0.04	−0.40	−0.23	−0.13	−5.1	−0.1
Apr. 11	Leiden	176 B. Cancri	I	−1.07	−0.96	−0.11	−0.03	−0.11	−0.16	−0.36	0.00	−0.93	−3.8	+1.5
13	Greenwich	37 Sextantis	I	−0.78	−0.55	−0.68	+0.13	−0.69	+0.17	−0.40	−0.20	−0.51	−9.1	−5.2
May 5	Leiden	112 B. Aurigæ	I	−0.66	−0.51	+0.37	+0.70	+0.79	−0.11	+0.01	+0.80	−0.40	−3.2	+0.1
5	Leiden	112 B. Aurigæ	EB	+0.86	+0.66	+0.30	+0.55	+0.62	+0.06	0.00	+0.57	+0.52	+2.5	−1.6
7	Leiden	82 Geminor.	I	−1.08	−0.98	+0.14	+0.09	+0.16	−0.18	+0.25	+0.21	−0.90	−4.6	+0.8
Aug. 18	Cape	η Piscium	IB	+0.03	−0.01	+0.44	−0.90	−1.00	−0.39	−0.11	+0.07	−0.04	+0.1	+0.3
18	Cape	η Piscium	E	+0.38	−0.08	+0.40	−0.83	−0.91	−0.33	−0.24	−0.43	−0.37	+2.4	[illegible]
Sept. 21	Greenwich	μ^2 Cancri	E	+0.97	+0.84	+0.44	+0.16	+0.47	+0.07	+0.26	+0.36	−0.77	+6.0	[illegible]
Oct. 28	Cape	α Scorpii	I	−0.97	+0.22	−0.07	−0.18	+0.20	−0.13	−0.13	−0.14	−0.42	−5.4	[illegible]
28	Cape	α Scorpii	EB	+0.88	−0.21	−0.18	−0.43	+0.47	+0.04	+0.13	−0.46	+0.38	+5.9	+1.6
Nov. 8	Cape	η Piscium	I	−0.55	+0.21	+0.30	−0.77	−0.83	−0.38	+0.14	−0.27	−0.20	−1.4	+1.4
11	Leiden	χ Tauri	IB	−0.93	−0.29	+0.16	+0.44	+0.46	−0.07	+0.14	+0.45	+0.28	−3.3	+1.5
Dec. 8	Greenwich	23 Tauri	I	−0.86	−0.17	+0.12	+0.54	+0.56	−0.01	+0.19	+0.51	−0.10	−6.2	−1.7
8	Greenwich	23 Tauri	EB	+0.74	+0.14	+0.15	+0.68	+0.70	+0.24	−0.14	+0.56	+0.09	−1.8	−5.5
8	Greenwich	28 Tauri	I	−0.81	−0.16	+0.14	+0.61	+0.63	0.00	+0.18	+0.57	−0.09	−5.1	−0.9
8	Greenwich	27 Tauri	I	−0.13	−0.02	+0.22	+0.96	+0.99	+0.17	+0.04	+0.85	−0.01	−2.2	−1.5
8	Greenwich	17 Tauri	EB	+1.01	+0.19	−0.05	−0.22	−0.23	+0.10	−0.21	−0.25	+0.12	+1.8	−3.2
8	Greenwich	η Tauri	I	−1.00	−0.19	+0.06	+0.26	+0.27	−0.09	+0.21	+0.29	−0.12	−3.3	[illegible]
21	Cape	σ Scorpii	IB	−0.91	+0.08	+0.13	+0.34	−0.37	−0.03	−0.10	+0.34	+0.47	−4.3	+0.4
21	Cape	α Scorpii	IB	0.81	+0.07	−0.23	−0.51	+0.55	−0.14	−0.10	−0.45	+0.42	−4.6	−0.4
1860, Jan. 4	Greenwich	17 Tauri	I	0.61	−0.08	+0.19	+0.79	+0.81	+0.06	+0.14	+0.71	−0.37	−5.2	−2.0
4	Greenwich	q Tauri	I	−0.90	−0.11	−0.12	0.48	−0.49	−0.22	+0.17	−0.35	−0.54	−5.7	−1.0
4	Greenwich	20 Tauri	I	−0.90	−0.12	−0.06	0.25	−0.26	−0.11	−0.01	+0.03	−0.60	−8.3	−3.2
6	Leiden	112 B. Aurigæ	I	−1.05	−0.50	−0.18	−0.21	−0.27	−0.20	0.00	−0.22	−0.28	−8.1	−2.6
Feb. 13	Cape	A Scorpii	IB	−0.87	−0.21	−0.15	−0.45	0.48	−0.18	−0.15	−0.34	+0.88	−6.6	−2.1
28	Camb., Eng.	16 Tauri	I	−0.46	−0.02	+0.25	+0.84	0.88	+0.13	+0.11	+0.77	−0.45	−4.2	−1.8
28	Camb., Eng.	20 Tauri	I	−0.70	−0.03	+0.20	+0.67	+0.70	+0.06	+0.15	+0.64	−0.69	−4.3	−0.7
28	Camb., Eng.	22 Tauri	I	−0.97	−0.04	+0.04	+0.12	+0.13	−0.06	+0.20	+0.18	−0.99	−5.7	−0.7
28	Greenwich	q Tauri	I	−0.92	−0.04	+0.09	+0.31	+0.32	−0.02	+0.20	+0.33	−0.95	−3.8	+1.0
28	Greenwich	16 Tauri	I	−0.39	−0.02	+0.27	+0.88	+0.92	+0.14	+0.10	+0.80	−0.40	−2.9	−0.9
28	Greenwich	22 Tauri	I	−0.96	−0.04	+0.05	+0.16	+0.17	−0.05	+0.21	+0.11	−0.99	−5.1	−0.1
28	Greenwich	20 Tauri	I	−0.65	−0.03	+0.21	+0.71	+0.74	+0.08	+0.15	+0.66	−0.67	−4.7	−1.3
Mar. 1	Leiden	112 B. Aurigæ	I	−0.94	−0.42	−0.28	−0.30	−0.41	−0.13	0.00	−0.35	−0.85	−3.1	+1.8
1	Leiden	112 B. Aurigæ	EB	+0.95	+0.42	−0.27	0.26	−0.38	+0.13	+0.01	−0.44	+0.86	+2.0	−2.8
4	Leiden	δ Cancri	I	−0.95	−0.77	[illegible]	0.03	−0.54	−0.05	−0.22	−0.41	−0.44	−4.0	+0.9
4	Leiden	δ Cancri	EB	+0.88	+0.72	−0.02	−0.03	−0.62	+0.38	+0.23	−0.55	+0.41	−0.1	−4.5
4	Greenwich	δ Cancri	I	−0.99	−0.81	−0.47	−0.02	−0.47	−0.06	−0.32	−0.32	−0.48	−5.1	0.0
5	Greenwich	18 Leonis	I	−1.11	−0.96	−0.20	+0.05	−0.21	−0.16	−0.42	−0.05	−0.32	−7.8	−2.0
7	Cape	υ Leonis	IB	−0.75	−0.63	+0.55	−0.52	+0.76	−0.52	−0.20	+0.13	+0.07	−4.1	−0.2
7	Cape	υ Leonis	E	+1.06	+0.87	+0.28	−0.27	+0.39	+0.08	+0.46	0.00	−0.09	+3.9	−1.4
12	Cape	α Scorpii	IB	−0.78	−0.07	−0.30	−0.55	+0.62	−0.16	−0.09	−0.53	+0.73	−4.3	−0.2
12	Cape	α Scorpii	E	+0.92	+0.08	−0.18	−0.33	+0.37	+0.07	+0.12	−0.41	−0.86	+7.6	+3.0
28	Cape	354 B. Tauri	I	−0.66	−0.22	−0.49	−0.55	−0.73	−0.08	+0.02	−0.66	−0.67	+2.4	+5.8
Apr. 27	Cape	μ Cancri	I	−0.78	−0.59	−0.66	−0.10	−0.67	+0.06	−0.24	−0.57	−0.74	−4.7	−0.6
May 1	Cape	υ Leonis	I	−0.96	−0.85	+0.34	−0.35	+0.49	−0.40	−0.33	+0.09	−0.62	−5.6	−0.6
8	Cape	λ Sagittarii	E	+0.77	−0.23	+0.52	+0.33	−0.62	+0.01	−0.10	+0.66	−0.52	+5.2	+1.3
25	Cape	δ Cancri	I	−0.88	−0.70	+0.56	−0.02	+0.56	−0.33	−0.24	+0.42	−0.76	−4.1	+0.5
June. 1	Leiden	50 G. Libræ	I	−0.77	−0.34	−0.18	−0.67	+0.69	−0.28	−0.16	−0.45	−0.31	−4.9	−0.9

GROUP XI—1857-1873—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	h_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1860, June 3	Cape	A^2 Ophiuchi	IB	−0.98	−0.02	−0.20	−0.20	+0.28	−0.14	−0.03	−0.23	+0.03	−7.0	−1.9
3	Cape	A^2 Ophiuchi	E	+0.84	+0.02	−0.39	−0.40	+0.56	+0.09	+0.03	−0.61	−0.02	+5.1	+0.9
3	Cape	A^1 Ophiuchi	E	+0.84	+0.02	−0.39	−0.40	+0.56	+0.09	+0.03	−0.61	−0.02	−0.6	−4.8
Aug. 24	Cape	A^1 Ophiuchi	I	−0.84	−0.18	−0.38	−0.34	+0.51	−0.09	−0.01	−0.44	−0.85	−5.0	−0.6
30	Cape	θ Aquarii	E	+0.90	−0.89	+0.11	−0.07	−0.13	−0.04	−0.43	+0.05	+0.18	+1.5	−3.0
Sept. 6	Greenwich	η Tauri	E	+0.91	−0.37	−0.09	−0.19	−0.21	0.00	−0.19	−0.26	−0.96	+5.1	+0.5
6	Greenwich	27 Tauri	E	+0.84	−0.34	+0.20	+0.40	+0.45	+0.12	−0.16	+0.32	−0.87	+4.0	−0.3
6	Greenwich	28 Tauri	E	+0.93	−0.38	+0.07	+0.14	+0.16	+0.07	−0.18	+0.06	−0.97	+6.6	+1.9
Oct. 17	Cape	22 Scorpii	I	−0.74	−0.34	+0.47	+0.54	−0.72	−0.16	+0.04	+0.63	−0.41	−4.3	−0.4
Nov. 5	Leiden	o^1 Cancri	IB	−0.94	−0.63	+0.43	−0.10	+0.44	−0.28	−0.28	+0.42	+0.90	−5.8	−0.8
5	Leiden	o^1 Cancri	E	+0.94	+0.63	+0.43	−0.11	+0.44	+0.03	+0.33	+0.26	−0.90	+4.8	0.0
5	Leiden	o^2 Cancri	IB	−0.84	−0.57	−0.57	+0.14	−0.59	+0.08	−0.32	−0.39	+0.81	−4.8	−0.4
5	Leiden	o^2 Cancri	E	+0.86	+0.58	−0.53	+0.13	−0.55	+0.29	+0.25	−0.50	−0.83	+3.6	−0.8
Dec. 19	Leiden	16 Piscium	I	−0.70	+0.76	+0.31	−0.54	−0.62	−0.27	+0.28	+0.13	−0.78	−2.8	+0.9
1861, Mar. 19	Greenwich	5 Geminor.	I	−0.70	+0.26	+0.65	+0.21	+0.68	−0.10	−0.07	+0.75	−0.72	−3.8	−0.1
Apr. 19	Leiden	o Leonis	I	−0.98	−0.60	−0.32	+0.23	−0.39	0.00	−0.39	−0.14	−0.78	−6.8	−1.6
27	Leiden	151 G. Ophiuchi	E	+1.04	+0.58	+0.26	+0.13	−0.29	+0.17	−0.01	+0.21	−0.61	+5.6	+0.3
May 19	Leiden	13 B. Virginis	I	−1.10	−0.93	+0.01	−0.03	+0.03	−0.21	−0.42	+0.10	−0.82	−8.7	−2.9
June 11	Leiden	ζ Cancri	I	−1.00	−0.18	−0.08	+0.02	−0.08	−0.07	−0.30	+0.02	−0.71	−1.7	+3.6
11	Leiden	ζ Cancri	EB	+0.98	+0.18	−0.19	+0.06	−0.19	+0.14	−0.28	−0.25	+0.70	+3.4	−1.6
25	Greenwich	18 Aquarii	IB	−0.44	+0.11	+0.76	−0.49	−0.90	−0.37	+0.10	+0.64	+0.26	−2.9	−0.6
Sept. 14	Greenwich	π Capricor.	I	−0.93	−0.17	−0.30	+0.13	+0.33	+0.02	+0.30	−0.20	−0.80	−4.6	+0.3
14	Greenwich	ρ Capricor.	I	−0.88	−0.16	+0.42	−0.18	−0.46	−0.21	+0.25	+0.45	−0.76	+3.1	+7.8
26	Leiden	9 Geminor.	E	+0.66	−0.34	−0.70	−0.09	−0.71	+0.09	+0.07	−0.77	−0.69	+4.2	+0.8
26	Leiden	11 Geminor.	E	+0.90	−0.46	+0.29	+0.03	+0.29	+0.01	+0.10	+0.20	−0.95	+5.3	+0.7
Oct. 15	Leiden	22 B. Piscium	I	−0.81	+0.51	−0.16	+0.46	+0.48	+0.19	+0.41	−0.02	−0.56	−5.7	−1.4
15	Leiden	9 Piscium	I	−0.89	+0.56	+0.07	−0.24	−0.25	−0.12	+0.38	+0.13	−0.62	−5.2	−0.5
15	Leiden	9 Piscium	EB	+0.92	−0.58	−0.01	+0.04	+0.04	+0.02	−0.40	−0.09	+0.64	+0.2	−4.5
15	Leiden	κ Piscium	I	−0.52	+0.35	+0.24	−0.80	−0.83	−0.36	+0.16	+0.19	−0.34	−1.4	+1.4
15	Leiden	κ Piscium	EB	+0.72	−0.48	+0.18	−0.60	−0.63	−0.25	−0.38	+0.05	+0.48	0.0	−3.7
19	Leiden	B.D.+18° 325	E	+0.68	−0.76	+0.36	+0.55	+0.65	+0.16	−0.18	+0.33	−0.17	+2.4	−1.1
20	Leiden	ζ Arietis	E	+0.83	−0.90	+0.27	+0.30	+0.40	+0.08	−0.19	+0.21	−0.35	+3.9	−0.3
20	Greenwich	ζ Arietis	IB	−0.89	+0.97	+0.09	+0.10	+0.14	+0.04	+0.23	+0.17	+0.36	−8.9	−4.2
22	Greenwich	103 Tauri	IB	−0.89	+0.76	−0.18	−0.07	−0.19	0.00	+0.02	−0.09	+0.74	−7.1	−2.4
Dec. 23	Leiden	e Leonis	IB	−1.03	−0.65	+0.01	−0.04	+0.04	−0.13	−0.41	+0.10	+0.99	−6.0	−0.5
1862, Feb. 4	Washington	101 Piscium	I	−0.59	+0.56	+0.31	+0.70	+0.76	+0.25	+0.27	+0.38	−0.59	−3.2	−0.1
Mar. 9	Greenwich	6 Geminor.	I	−0.87	+0.74	+0.33	0.00	+0.33	−0.03	−0.09	+0.41	−0.90	−3.7	+0.9
15	Leiden	e Leonis	IB	−1.08	−0.50	+0.01	−0.08	+0.08	−0.20	−0.40	+0.10	+0.05	−6.7	−1.0
15	Leiden	e Leonis	E	+1.06	+0.49	−0.03	+0.19	−0.19	+0.24	+0.39	−0.13	−0.05	+5.3	−0.1
Apr. 15	Leiden	43 B. Libræ	IB	−1.14	−0.95	−0.09	−0.08	+0.12	−0.26	−0.23	+0.02	+0.36	−8.4	−2.4
15	Greenwich	43 B. Libræ	E	+1.15	+0.97	−0.03	−0.03	+0.04	+0.23	+0.23	−0.24	−0.38	+7.5	+1.6
May 8	Washington	55 Leonis	I	−1.02	−0.29	+0.04	−0.12	+0.14	−0.15	−0.38	+0.13	−0.83	−6.7	−1.3
11	Washington	75 Virginis	I	−1.08	−0.78	−0.15	−0.30	+0.31	−0.32	−0.29	−0.04	−0.33	−5.2	+0.5
June 9	Radcliffe	43 B. Libræ	I	−1.14	−0.96	0.00	0.00	0.00	−0.22	−0.23	+0.11	−0.45	−4.6	+1.4
July 15	Greenwich	κ Piscium	E	+0.90	−0.06	+0.02	−0.43	−0.43	−0.10	−0.40	+0.01	−0.70	+6.0	+1.5
15	Greenwich	9 Piscium	E	+0.98	−0.07	−0.01	+0.18	+0.18	+0.15	−0.38	−0.12	−0.76	+1.0	−3.9
21	Greenwich	υ Tauri	E	+0.80	−0.88	−0.44	−0.13	−0.46	−0.05	−0.07	−0.49	−0.73	+3.4	−0.6
Aug 1	Washington	75 Virginis	I	−1.05	−0.74	+0.01	+0.02	−0.02	−0.13	−0.33	+0.11	−0.99	−5.0	+0.5
Sept. 3	Greenwich	π Sagittarii	I	−0.19	−0.16	+0.89	−0.40	−0.98	−0.19	+0.02	+0.10	−0.15	−0.3	+0.7
Oct. 11	Greenwich	κ Tauri	IB	−0.87	+0.93	−0.28	−0.06	−0.29	−0.02	+0.10	−0.19	+0.67	−7.9	−3.4
11	Greenwich	κ Tauri	E	+0.89	−0.95	−0.18	−0.04	−0.18	−0.03	−0.08	−0.26	−0.69	+4.4	−0.1
29	Washington	τ Capricor.	I	−0.96	−0.72	+0.27	−0.29	−0.40	−0.22	−0.27	+0.40	−0.92	−3.9	+1.1
Dec. 7	Cape	μ Geminor.	E	+0.90	−0.99	+0.03	−0.01	+0.03	−0.01	+0.12	+0.04	−0.30	+5.8	−1.3
10	Greenwich	α Cancri	IB	−0.73	+0.50	+0.35	−0.50	+0.61	−0.19	−0.22	+0.53	+0.68	−9.1	−5.3
10	Greenwich	α Cancri	E	+0.86	−0.59	+0.20	−0.29	+0.35	−0.12	+0.31	+0.15	−0.80	+8.5	+4.2
13	Cape	p^3 Leonis	IB	−0.92	+0.05	−0.01	−0.31	+0.31	−0.17	−0.34	+0.14	+0.94	+1.0	+5.8
1863, Jan. 9	Leiden	55 Leonis	E	+0.95	−0.10	0.00	+0.03	−0.03	+0.04	+0.38	−0.10	−0.87	+5.6	+0.0
27	Leiden	δ Arietis	EB	+0.91	−0.66	−0.15	−0.07	−0.17	−0.03	−0.20	−0.20	+0.98	+4.7	+0.2
27	Radcliffe	δ Arietis	I	−0.84	+0.60	−0.38	−0.18	−0.42	−0.08	+0.17	−0.24	−0.90	−5.2	−0.8
27	Radcliffe	δ Arietis	EB	+0.90	−0.65	−0.19	−0.09	−0.21	−0.04	−0.19	−0.24	+0.97	+3.8	−0.7
27	Greenwich	δ Arietis	I	−0.85	+0.61	−0.38	−0.10	−0.39	−0.07	+0.17	−0.24	−0.91	−4.5	−4.7
27	Greenwich	δ Arietis	EB	+0.90	−0.65	−0.17	−0.04	−0.18	−0.04	−0.17	−0.20	+0.97	−1.0	−5.5
27	Cape	ζ Arietis	I	−0.90	+0.6[illegible]	0.15	+0.06	+0.16	+0.03	+0.19	+0.14	−0.98	−4.3	+0.4
Feb. 23	Washington	δ Arietis	I	−0.72	+0.4[illegible]	0.59	−0.26	−0.63	−0.13	+0.14	−0.41	−0.72	−0.5	+3.2
Mar. 2	Leiden	α Cancri	I	−0.87	+0.73	+0.17	0.31	+0.35	−0.11	−0.28	+0.31	−0.42	−6.4	−1.9
2	Leiden	α Cancri	EB	+0.93	−0.78	+0.05	−0.09	+0.10	−0.03	+0.32	+0.02	+0.45	+7.7	+3.1
2	Radcliffe	α Cancri	I	−0.82	+0.69	−0.24	−0.40	+0.47	−0.15	−0.25	+0.43	−0.40	−4.4	−0.1
2	Greenwich	α Cancri	I	−0.83	+0.70	+0.23	−0.40	+0.46	−0.14	−0.14	+0.42	−0.40	−6.8	−2.[illegible]
12	Cape	58 Ophiuchi	E	+1.07	+0.98	−0.08	+0.02	+0.08	+0.15	−0.04	−0.09	−0.99	+4.3	−1.0
22	Washington	40 Arietis	I	−0.90	+0.50	−0.30	−0.16	−0.34	−0.11	+0.21	−0.18	−0.59	−6.5	−1.8

GROUP XI—1857-1873—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_1	α_0	δ_0	s	P	n	n'
													″	″
1863, Mar. 24	Leiden	51 Tauri	I	−0.22	+0.19	−0.97	−0.10	−0.97	−0.08	+0.02	−0.85	−0.21	−3.1	−2.0
24	Leiden	53 Tauri	EB	+0.62	−0.54	+0.74	+0.07	+0.74	+0.06	−0.06	+0.61	+0.58	+5.0	+1.9
Apr. 2	Leiden	13 B. Aurigæ	I	−0.54	+0.05	−0.26	−0.80	+0.84	−0.35	−0.14	+0.11	−0.08	−2.8	0.0
7	Cape	ω Ophiuchi	IB	−0.89	−0.72	+0.57	+0.03	−0.57	−0.10	−0.07	+0.46	+0.66	−4.1	+0.4
8	Cape	58 Ophiuchi	IB	−1.07	−0.97	+0.10	−0.03	−0.11	−0.17	+0.03	+0.10	+0.92	−5.8	−0.3
9	Washington	36 Sagittarii	E	+0.91	+0.85	+0.46	−0.28	−0.54	+0.05	−0.14	+0.45	−0.84	+5.0	+0.5
21	Washington	105 Tauri	I	−0.90	+0.88	−0.19	+0.02	−0.19	0.00	0.00	−0.09	−0.70	−5.4	−0.8
25	Washington	29 Canceri	I	−0.72	+0.72	−0.34	+0.49	−0.60	+0.18	−0.24	−0.43	−0.80	−0.8	+2.9
26	Greenwich	κ Canceri	I	−0.89	+0.79	+0.10	−0.21	+0.23	−0.06	−0.30	+0.26	−0.94	−3.4	+1.1
26	Greenwich	κ Canceri	EB	+0.92	−0.81	0.00	0.00	0.00	−0.01	+0.32	−0.09	+0.97	+4.5	0.0
29	Radcliffe	e Leonis	I	−0.86	+0.20	+0.10	+0.46	−0.47	+0.13	−0.36	+0.02	−0.52	−4.6	−0.8
29	Radcliffe	e Leonis	EB	+0.74	−0.17	+0.14	+0.64	−0.65	+0.28	+0.24	−0.16	+0.43	−2.0	−5.6
30	Washington	q Virginis	I	−0.94	−0.04	−0.20	−0.35	+0.40	−0.23	−0.29	+0.02	−0.37	−3.8	+1.0
May 4	Cape	ω^2 Scorpii	IB	−0.55	−0.39	+0.86	+0.10	−0.87	−0.01	−0.07	+0.73	+0.18	−3.7	−0.9
June 28	Cape	ω^2 Scorpii	I	−0.67	−0.44	+0.79	+0.05	−0.80	−0.03	−0.09	+0.66	−0.31	−2.8	+0.6
28	Cape	ω^2 Scorpii	EB	+0.46	+0.30	+0.91	+0.05	−0.91	+0.18	+0.03	+0.36	+0.21	+4.8	+2.5
30	Cape	21 Sagittarii	EB	+1.09	+0.92	+0.28	−0.16	−0.32	+0.19	−0.11	+0.36	+0.06	+5.8	+0.5
July 28	Greenwich	36 Sagittarii	I	−1.07	−0.92	+0.29	+0.22	+0.36	−0.25	+0.13	+0.42	−0.36	−2.1	+3.4
Aug. 7	Leiden	ω Tauri	IB	−0.87	+0.53	+0.31	0.00	+0.31	+0.05	+0.19	+0.35	+0.92	−6.4	−2.0
27	Washington	c^1 Capricor.	I	−1.02	−0.81	+0.07	−0.43	−0.44	−0.33	+0.28	+0.32	−0.22	−4.4	+0.8
30	Washington	51 Piscium	IB	−1.03	−0.40	+0.16	+0.23	+0.28	−0.04	+0.35	+0.10	+0.33	−5.3	0.0
30	Washington	51 Piscium	E	+0.94	+0.37	+0.29	+0.40	+0.49	+0.31	−0.28	+0.02	−0.30	−5.2	−9.8
Sept. 24	Washington	51 Aquarii	I	−0.78	−0.60	−0.06	−0.70	−0.71	−0.37	−0.20	+0.36	−0.38	−0.8	+3.2
Oct. 22	Radcliffe	κ Aquarii	I	−0.96	−0.71	+0.06	+0.46	+0.46	+0.03	+0.34	−0.13	−0.72	−4.7	+0.2
23	Greenwich	16 Piscium	I	−0.51	−0.36	−0.37	−0.80	−0.88	−0.37	+0.11	−0.14	−0.31	−0.7	+1.9
23	Radcliffe	16 Piscium	I	−0.46	−0.29	−0.35	−0.83	−0.90	−0.38	+0.10	+0.13	−0.29	−1.6	+0.7
23	Leiden	16 Piscium	I	−0.59	+0.48	−0.35	−0.76	−0.83	−0.37	+0.15	+0.16	−0.37	−1.2	+1.8
30	Leiden	χ^1 Orionis	E	+0.89	−0.75	+0.23	+0.12	+0.26	−0.02	+0.05	+0.19	−0.67	+3.9	−0.4
30	Radcliffe	χ^1 Orionis	IB	−0.93	+0.77	+0.01	0.00	+0.01	0.00	−0.05	+0.08	+0.69	−8.5	−3.8
30	Radcliffe	χ^1 Orionis	E	+0.91	−0.75	+0.18	−0.10	+0.21	−0.01	+0.05	+0.14	−0.68	+5.9	+1.5
30	Greenwich	χ^1 Orionis	E	+0.93	−0.75	+0.06	−0.03	+0.07	+0.02	+0.05	+0.17	−0.67	+4.2	−0.2
Nov 3	Washington	ω Leonis	IB	−0.86	+0.91	+0.05	−0.30	+0.31	−0.07	−0.28	+0.26	+0.94	−3.6	+0.7
17	Cape	ξ Aquarii	I	−1.04	−0.94	−0.02	+0.26	+0.26	−0.06	+0.33	−0.54	−0.97	−3.3	+1.9
19	Washington	9 Piscium	I	−0.92	−0.67	−0.17	−0.40	−0.44	−0.24	+0.29	+0.13	−0.86	−2.1	+2.5
19	Washington	κ Piscium	I	−0.35	−0.25	−0.37	−0.86	−0.94	−0.37	+0.06	+0.18	−0.31	+0.3	+2.0
19	Leiden	κ Piscium	I	−1.00	−0.71	−0.12	−0.28	−0.30	−0.22	+0.28	+0.12	−0.90	−4.6	+0.4
19	Leiden	9 Piscium	I	−1.01	−0.72	+0.12	+0.26	+0.28	−0.01	+0.36	+0.01	−0.91	−4.6	+0.5
30	Leiden	60 Canceri	IB	−0.88	+0.98	−0.07	+0.21	−0.22	+0.10	−0.30	−0.14	+0.87	−8.2	−3.8
30	Leiden	60 Canceri	E	+0.89	−0.99	−0.05	+0.15	−0.16	+0.01	+0.28	−0.14	−0.88	+4.7	+0.4
Dec. 19	Radcliffe	π Piscium	I	−0.74	−0.20	+0.57	+0.36	+0.67	+0.15	+0.25	+0.32	−0.67	−5.4	−1.7
24	Leiden	χ^2 Orionis	EB	+0.92	−0.72	+0.08	−0.06	+0.10	−0.02	+0.07	+0.02	+0.14	−2.3	−6.7
27	Leiden	A^1 Canceri	IB	−0.89	+0.99	−0.05	+0.13	−0.14	+0.07	−0.27	−0.04	+0.50	−7.1	−2.6
27	Leiden	A^1 Canceri	E	+0.86	−0.96	−0.08	+0.27	−0.28	+0.05	+0.26	−0.30	−0.51	+4.1	0.0
27	Leiden	A^2 Canceri	IB	−0.74	+0.82	+0.16	−0.54	+0.56	−0.13	−0.22	+0.50	+0.42	−7.5	−3.8
27	Leiden	A^2 Canceri	E	+0.84	−0.94	+0.09	−0.32	+0.33	−0.13	+0.28	+0.18	−0.50	+3.5	−0.5
30	Leiden	p^3 Leonis	E	+0.91	−0.77	+0.01	+0.04	−0.04	−0.01	+0.34	+0.06	−0.94	+5.6	+1.2
1864, Jan. 24	Leiden	κ Canceri	IB	−0.70	+0.78	+0.12	−0.62	+0.63	−0.16	+0.20	+0.51	+0.16	−8.9	−5.4
24	Leiden	κ Canceri	E	+0.64	−0.71	+0.13	−0.69	+0.70	−0.23	+0.24	+0.45	−0.14	+0.2	−2.9
Feb. 13	Washington	53 Arietis	I	−0.84	−0.08	−0.54	−0.06	−0.54	−0.16	+0.15	−0.34	−0.79	−4.2	0.0
14	Washington	43 Tauri	I	−0.54	+0.11	+0.81	−0.13	+0.82	+0.08	+0.06	+0.78	−0.57	−4.1	−1.4
14	Washington	43 Tauri	EB	+0.70	−0.14	+0.67	−0.12	+0.68	+0.08	−0.08	+0.56	+0.73	−2.3	−5.6
16	Washington	χ Orionis	I	−0.91	+0.58	+0.11	−0.07	+0.13	+0.02	−0.05	+0.19	−0.90	−5.9	−1.3
16	Washington	χ Orionis	EB	+0.91	+0.58	−0.10	−0.07	−0.12	−0.02	+0.05	−0.11	+0.90	0.0	−4.3
25	Washington	49 Virginis	E	+0.06	−0.03	+0.82	+0.57	−1.00	+0.30	−0.03	+0.30	−0.05	−0.3	−0.6
29	Cape	ψ Ophiuchi	IB	−1.00	−0.44	−0.13	+0.03	+0.13	−0.09	−0.09	−0.06	+0.98	−8.1	−3.1
29	Cape	ψ Ophiuchi	E	+1.01	+0.44	+ .12	−0.03	−0.12	+0.10	+0.09	+0.04	−0.98	−6.3	−11.1
Mar. 18	Greenwich	A^1 Canceri	IB	−0.68	+0.74	−0.16	+0.63	−0.65	+0.22	−0.23	−0.44	−0.57	−5.5	−2.2
18	Greenwich	A^2 Canceri	I	−0.89	+0.97	+0.03	−0.13	+0.13	0.00	−0.26	+0.18	−0.74	−6.3	−1.9
18	Radcliffe	A^2 Canceri	I	−0.89	+0.97	+0.03	−0.14	+0.14	0.00	−0.26	+0.19	−0.74	−6.0	−1.6
18	Leiden	A^2 Canceri	I	−0.90	+0.98	+0.01	−0.03	+0.03	+0.03	−0.26	+0.09	−0.75	−8.2	−3.8
18	Leiden	A^2 Canceri	EB	+0.87	−0.95	−0.05	+0.22	−0.23	+0.03	+0.26	−0.26	+0.73	+3.4	−0.7
19	Leiden	ω Leonis	I	−0.90	+1.00	0.00	+0.08	−0.08	+0.05	−0.31	+0.01	−0.62	−6.6	−2.2
19	Leiden	ω Leonis	EB	+0.88	−0.98	−0.01	+0.21	−0.21	+0.03	+0.29	−0.20	+0.61	−2.6	−6.7
19	Radcliffe	ω Leonis	EB	+0.89	−0.99	−0.01	+0.13	−0.13	0.00	+0.30	−0.16	+0.63	−0.1	−4.3
19	Greenwich	ω Leonis	I	−0.90	+1.00	0.00	+0.03	−0.03	+0.04	−0.31	+0.05	−0.64	−5.5	−1.1
24	Cape	α Virginis	IB	−0.77	+0.30	−0.51	−0.29	+0.59	−0.19	−0.20	−0.18	+0.34	−6.3	−2.5
24	Cape	α Virginis	E	+0.92	−0.36	−0.21	−0.11	+0.23	−0.05	+0.30	−0.13	−0.41	+5.3	+1.0
27	Cape	ν Scorpii	IB	−0.67	−0.22	+0.73	−0.16	−0.75	+0.02	−0.09	+0.61	+0.60	−5.1	−1.8
Apr. 11	Radcliffe	57 Orionis	E	+0.86	−0.49	−0.35	+0.26	−0.44	+0.04	+0.05	−0.51	+0.83	−0.3	−4.3
20	Leiden	49 Virginis	I	−0.87	+0.46	+0.35	+0.23	−0.41	+0.11	−0.30	+0.18	−0.11	−4.2	+0.1

GROUP XI—1857–1873—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	t	P	n	n'
													″	″
1864, Apr. 20	Leiden	49 Virginis	E	+0.74	−0.38	+0.55	+0.34	−0.64	+0.21	+0.20	+0.12	+0.09	− 0.2	−3.7
23	Leiden	λ Libræ	I	−0.98	−0.17	+0.25	−0.04	−0.25	−0.04	−0.13	+0.29	+0.49	− 7.9	−3.1
27	Cape	*c* Sagittarii	E	+0.88	+0.74	+0.25	−0.50	−0.56	0.00	−0.18	+0.52	−0.81	+ 6.6	+2.5
May 20	Washington	χ Libræ	I	−0.96	−0.08	+0.35	−0.05	−0.36	−0.03	−0.15	+0.32	+0.03	− 1.7	+3.0
June 20	Washington	*d* Sagittarii	IB	−0.04	−0.03	−0.51	+0.86	+1.00	+0.14	+0.02	−1.00	+0.01	− 2.7	−2.5
26	Greenwich	62 Piscium	E	+0.80	+0.61	+0.54	+0.36	+0.65	+0.30	−0.22	+0.11	−0.75	− 0.1	−3.8
26	Greenwich	δ Piscium	IB	−1.00	−0.75	−0.27	−0.18	−0.32	−0.21	+0.29	−0.01	+0.94	− 8.7	−3.9
26	Greenwich	δ Piscium	E	+1.04	+0.78	−0.14	−0.10	−0.17	+0.06	0.00	−0.09	−0.98	+ 7.8	+3.0
July 18	Cape	*c* Sagittarii	I	−0.98	−0.70	+0.19	−0.46	−0.50	−0.27	+0.15	+0.45	−0.02	− 4.8	−0.1
18	Cape	*c* Sagittarii	E	+1.10	+0.78	+0.08	−0.20	−0.21	+0.15	−0.19	+0.16	+0.02	+ 5.2	+0.1
23	Washington	62 Piscium	E	+0.46	+0.37	−0.76	+0.50	+0.90	+0.34	−0.09	+0.16	−0.40	+ 1.9	−0.2
23	Washington	δ Piscium	IB	−1.07	−0.83	−0.09	−0.06	−0.10	−0.17	+0.31	+0.03	+0.91	− 5.6	−0.5
23	Washington	δ Piscium	E	+1.05	+0.81	+0.19	+0.12	+0.23	+0.21	−0.30	−0.01	−0.88	+ 4.0	−0.8
Aug. 12	Washington	ξ Ophiuchi	I	−1.01	−0.07	−0.20	+0.14	+0.24	−0.10	−0.02	−0.18	−0.79	− 5.4	−0.6
Nov. 4	Washington	ρ Sagittarii	I	−0.95	−0.58	−0.14	+0.36	+0.39	−0.03	+0.15	−0.33	−0.86	− 2.2	+2.3
5	Washington	16 B. Capricor.	I	−0.82	−0.62	−0.07	+0.62	+0.63	+0.06	+0.21	−0.48	−0.77	− 4.3	−0.4
5	Washington	β Capricor.	I	−0.76	−0.57	−0.08	+0.69	+0.70	+0.07	−0.18	−0.56	−0.71	− 4.5	−0.9
10	Leiden	62 Piscium	I	−1.07	−0.86	−0.26	−0.13	−0.29	−0.26	+0.28	−0.02	−0.60	− 8.3	−3.2
10	Leiden	62 Piscium	EB	+1.08	+0.87	−0.21	−0.10	−0.23	+0.09	−0.32	−0.08	+0.60	+ 1.3	−3.6
19	Leiden	κ Cancri	IB	−0.68	+0.61	+0.06	+0.67	−0.67	+0.20	−0.23	−0.44	+0.70	− 4.6	−1.4
19	Leiden	κ Cancri	E	+0.72	−0.63	+0.06	+0.62	−0.62	+0.15	+0.19	−0.49	−0.74	+ 3.6	+0.4
Dec. 5	Greenwich	κ Aquarii	I	−0.83	−0.76	−0.33	−0.55	−0.64	−0.31	+0.21	+0.29	−0.77	− 2.1	+1.8
6	Cape	κ Piscium	I	−1.06	−1.00	+0.06	+0.06	+0.08	−0.11	+0.35	+0.06	−1.00	− 3.9	+1.1
6	Cape	κ Piscium	EB	+1.00	+0.93	+0.25	+0.26	+0.37	+0.26	−0.28	−0.12	+0.93	0.0	−4.5
1865, Jan. 8	Leiden	302 B. Tauri	I	−0.77	−0.22	+0.54	−0.37	+0.67	−0.02	+0.06	+0.67	−0.52	− 5.1	−1.5
8	Leiden	*i* Tauri	I	−0.57	−0.14	+0.67	−0.49	+0.83	+0.02	+0.04	+0.82	−0.36	− 5.1	−2.4
12	Washington	A^1 Cancri	IB	−0.94	+0.66	0.00	+0.05	−0.05	+0.02	0.00	+0.01	+0.20	− 5.8	−1.4
Feb. 2	Washington	σ Arietis	IB	−1.00	−0.69	+0.30	−0.05	+0.31	−0.03	+0.22	+0.25	+0.80	− 6.3	−1.6
9	Leiden	κ Cancri	I	−0.92	+0.71	−0.02	−0.10	+0.10	−0.01	−0.76	+0.12	−0.16	− 5.2	−0.9
Mar. 3	Greenwich	68 Tauri	I	−0.74	−0.35	+0.58	−0.38	+0.69	0.00	+0.07	+0.65	−0.71	− 5.2	−1.8
15	Cape	λ Virginis	IB	−0.55	+0.46	−0.80	+0.04	+0.80	−0.18	−0.11	−0.43	+0.43	− 3.3	−0.8
15	Cape	λ Virginis	E	+0.65	−0.55	−0.69	+0.04	+0.70	−0.20	+0.21	−0.42	−0.52	− 0.2	−3.1
Apr. 30	Leiden	67 Geminor.	I	−0.96	−0.98	−0.03	+0.18	−0.18	0.00	−0.16	−0.12	−0.89	− 2.8	+1.6
July 3	Greenwich	α Libræ	I	−0.62	+0.54	−0.71	+0.21	+0.74	−0.15	−0.12	−0.47	−0.54	− 4.7	−1.9
3	Greenwich	α Libræ	EB	+0.63	−0.56	−0.71	+0.21	+0.74	−0.17	+0.16	−0.54	+0.56	+ 2.1	−0.6
3	Leiden	8 Libræ	I	−0.75	+0.66	−0.57	+0.17	+0.59	−0.11	−0.17	−0.34	−0.66	− 5.0	−1.6
3	Leiden	α Libræ	I	−0.63	+0.57	−0.69	+0.21	+0.72	−0.13	−0.14	−0.44	−0.57	− 4.3	−1.5
8	Leiden	ρ Sagittarii	IB	−0.70	−0.12	+0.12	−0.73	−0.74	−0.16	+0.09	+0.71	+0.06	− 4.0	−0.9
Aug. 6	Leiden	8 Aquarii	IB	−0.92	−0.44	+0.16	+0.51	+0.54	+0.01	+0.22	−0.37	+0.01	− 4.9	−0.8
Sept. 11	Washington	115 Tauri	E	+0.49	−0.28	+0.48	−0.74	+0.88	+0.06	−0.01	+0.86	−0.47	+ 2.2	+0.1
29	Washington	16 B. Capricor.	I	−1.00	−0.30	+0.05	+0.25	+0.25	−0.03	+0.21	−0.18	−0.83	− 3.5	+0.9
29	Washington	β Capricor.	I	−0.98	−0.29	+0.06	+0.30	+0.31	−0.02	+0.19	−0.24	−0.82	− 3.6	+0.7
Oct. 4	Leiden	147 B. Piscium	IB	−1.14	−0.96	−0.18	−0.04	−0.18	−0.26	+0.29	−0.02	−0.04	− 8.3	−3.3
Nov. 4	Greenwich	64 Tauri	E	+0.76	+0.54	−0.52	+0.53	−0.74	+0.05	−0.08	−0.61	−0.20	− 0.1	−3.2
5	Leiden	115 Tauri	IB	−1.03	−0.61	+0.17	−0.17	+0.33	−0.12	+0.03	+0.37	+0.47	− 4.8	−0.3
5	Leiden	115 Tauri	E	+0.97	+0.57	+0.24	−0.41	+0.47	+0.14	−0.02	+0.43	−0.44	+ 3.1	−0.9
Dec. 30	Greenwich	115 Tauri	I	−0.81	−0.51	+0.31	−0.60	+0.67	−0.08	+0.02	+0.68	−0.29	− 4.2	−0.7
1866, Jan. 8	Radcliffe	*h* Virginis	IB	−0.05	+0.06	−0.99	+0.10	+1.00	−0.28	+0.03	−0.40	+0.06	− 2.0	−1.8
8	Radcliffe	*h* Virginis	E	+0.23	−0.24	−0.97	+0.10	+0.97	−0.28	+0.11	−0.40	−0.25	− 0.6	−1.5
Feb. 27	Radcliffe	*h* Leonis	I	−0.96	+0.25	−0.11	−0.16	+0.20	−0.08	−0.25	+0.16	−0.32	− 6.7	−2.6
Apr. 20	Washington	68 Geminor.	I	−1.03	−0.48	+0.02	+0.11	−0.11	−0.07	−0.15	−0.08	−0.97	− 4.1	−0.2
May 11	Cape	ζ Piscium	IB	−1.12	−0.9[illegible]	−0.08	+0.01	−0.08	−0.20	+0.29	−0.03	+0.47	− 8.7	−4.1
20	Cape	*o* Leonis	I	−0.06	0.00	−0.69	−0.72	+1.00	−0.26	+0.02	+0.62	−0.05	− 3.6	−3.3
June 18	Washington	75 Leonis	I	−0.68	+0.26	+0.66	+0.26	−0.70	+0.21	−0.26	−0.13	−0.68	− 3.1	−0.3
July 8	Cape	68 Tauri	E	+1.11	+0.97	+0.04	−0.06	+0.07	+0.18	−0.12	+0.09	−0.66	+ 8.0	+3.7
26	Cape	*c* Sagittarii	I	−0.93	+0.46	+0.07	+0.24	+0.25	+0.02	+0.13	−0.18	−0.14	− 6.6	−2.8
26	Cape	*e* Sagittarii	EB	+0.95	−0.46	−0.05	−0.16	−0.17	0.00	−0.13	+0.13	+0.14	− 1.9	−5.6
31	Washington	44 Piscium	IB	−0.93	−0.48	−0.46	−0.03	−0.46	−0.23	+0.25	−0.04	+0.60	+ 3.9	+7.7
31	Washington	44 Piscium	E	+0.97	+0.63	−0.38	−0.01	−0.38	−0.03	−0.31	−0.03	−0.79	− 7.0	−10.8
Aug. 29	Cape	*o* Piscium	E	+1.07	+0.85	−0.11	+0.04	−0.12	+0.10	−0.29	−0.03	−0.75	+ 6.5	+2.3
Sept. 15	Cape	φ Ophiuchi	I	−0.44	+0.48	+0.38	−0.78	−0.87	+0.12	−0.08	+0.79	−0.46	− 0.4	+1.4
15	Cape	φ Ophiuchi	EB	+0.49	−0.53	+0.36	−0.76	−0.84	+0.07	+0.05	+0.77	+0.52	+ 2.0	+0.1
28	Greenwich	75 Tauri	E	+1.08	+0.98	−0.08	+0.16	−0.18	+0.12	−0.14	−0.15	−0.82	+ 4.6	+0.4
28	Greenwich	α Tauri	E	+1.00	+0.91	+0.17	−0.38	+0.42	+0.16	−0.13	+0.39	−0.76	+ 3.8	−0.1
28	Leiden	99 Tauri	IB	−0.94	−0.85	+0.23	−0.47	+0.52	−0.14	−0.04	+0.51	+0.70	− 9.1	−5.3
28	Leiden	α Tauri	IB	−1.03	−0.94	+0.15	−0.32	+0.35	−0.10	+0.12	+0.31	+0.80	− 3.7	+0.4
29	Leiden	111 Tauri	IB	−0.93	−0.83	−0.12	+0.49	−0.51	−0.14	+0.05	−0.48	+0.79	−10.0	−6.3
29	Leiden	111 Tauri	E	+1.00	+0.90	−0.09	+0.37	−0.38	+0.10	−0.05	−0.39	−0.86	+ 3.3	−0.5
29	Leiden	117 Tauri	IB	−0.99	−0.88	+0.09	−0.38	+0.39	−0.10	+0.05	+0.40	−0.85	− 4.3	−0.3
29	Leiden	117 Tauri	E	+0.92	+0.82	+0.12	−0.52	+0.53	+0.14	−0.04	+0.50	−0.78	+ 3.4	−0.1

GROUP XI—1857–1873—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1866, Nov. 16	Greenwich	67 Aquarii	I	−0.86	−0.12	+0.47	+0.19	+0.51	+0.10	+0.18	−0.20	−0.81	−3.0	+0.4
20	Greenwich	ξ Arietis	I	−1.03	−0.79	−0.34	+0.24	−0.42	−0.29	+0.22	−0.24	−0.32	−3.4	+0.7
27	Greenwich	o Leonis	E	+0.97	+0.39	−0.26	−0.20	+0.33	−0.01	+0.24	+0.20	−0.86	+3.8	+0.1
Dec. 24	Washington	ξ Leonis	IB	−0.37	−0.20	+0.73	+0.59	−0.94	+0.18	−0.11	−0.60	+0.21	−5.5	−4.1
24	Washington	ξ Leonis	E	+0.39	+0.45	+0.73	+0.23	−0.93	+0.27	+0.06	−0.59	−0.58	+9.0	+7.5
1867, Jan. 29	Cape	φ Ophiuchi	E	+0.29	−0.33	−0.32	+0.89	+0.94	−0.14	+0.05	−0.86	−0.29	+1.0	−0.1
Apr. 8	Washington	318 B. Tauri	I	−1.09	−0.98	−0.02	+0.12	−0.12	−0.17	+0.11	−0.13	−0.82	−4.2	−0.1
16	Cape	η Virginis	I	−0.83	+0.08	+0.51	−0.11	−0.52	+0.13	−0.28	0.00	−0.38	−1.6	+1.5
16	Cape	η Virginis	EB	+0.70	−0.06	+0.68	−0.15	−0.70	+0.24	+0.18	+0.05	+0.32	−1.5	−4.0
18	Washington	96 Virginis	IB	−0.87	+0.52	−0.30	+0.25	+0.39	−0.10	−0.24	−0.22	+0.01	−4.2	−0.9
18	Washington	96 Virginis	E	+0.95	−0.56	−0.06	+0.04	+0.08	−0.02	+0.28	−0.21	−0.01	−2.8	−6.1
May 5	Washington	α Tauri	I	−1.10	−0.93	+0.05	−0.23	+0.25	−0.15	+0.12	+0.23	−0.40	−0.1	+4.0
5	Washington	α Tauri	EB	+1.13	+0.96	+0.01	−0.07	+0.07	+0.19	−0.14	+0.08	+0.41	+3.2	−0.8
June 14	Greenwich	49 Libræ	I	−0.85	+0.72	+0.19	−0.55	−0.58	+0.04	−0.17	+0.43	−0.38	−2.2	+0.9
July 9	Washington	κ Virginis	I	−0.89	+0.39	−0.22	+0.22	+0.31	−0.08	−0.26	−0.10	−0.94	−3.9	−0.7
9	Washington	κ Virginis	EB	+0.93	−0.41	−0.06	+0.06	+0.09	−0.04	+0.28	0.00	+0.99	−0.1	−3.3
Oct. 16	Leiden	85 Tauri	E	+1.04	+0.79	+0.03	−0.27	+0.27	+0.17	−0.14	+0.28	−0.66	+3.9	+0.4
Nov. 6	Radcliffe	λ Aquarii	I	−0.95	+0.50	−0.10	0.00	−0.10	−0.04	+0.29	−0.01	−0.23	−3.6	−0.3
8	Radcliffe	10 Ceti	I	−1.01	+0.12	−0.09	+0.04	−0.10	−0.10	+0.31	−0.06	−0.61	−4.4	−0.9
8	Greenwich	10 Ceti	I	−1.00	+0.12	−0.06	+0.03	−0.07	−0.08	+0.32	−0.05	−0.61	−2.2	+1.3
Dec. 28	Cape	τ Capricor.	I	−0.50	+0.54	−0.71	−0.44	−0.83	−0.11	+0.08	+0.67	−0.30	−0.5	+1.2
1868, Feb. 8	Leiden	A Leonis	E	+0.93	+0.74	−0.58	−0.07	+0.58	+0.01	+0.23	+0.32	−0.07	+5.0	+2.0
11	Leiden	k Virginis	E	+0.79	+0.28	−0.52	+0.40	+0.66	−0.14	+0.29	−0.13	−0.53	−0.9	−3.3
28	Leiden	μ Ceti	I	−0.47	−0.15	+0.36	−0.81	+0.89	+0.20	+0.15	+0.55	−0.42	−3.2	−1.6
28	Leiden	μ Ceti	EB	+0.54	+0.17	+0.34	−0.77	+0.84	+0.26	−0.12	+0.57	+0.51	−2.4	−4.1
28	Greenwich	μ Ceti	I	−0.35	−0.10	+0.40	−0.85	+0.94	+0.23	+0.13	+0.59	−0.32	−1.5	−0.3
29	Göttingen	f Tauri	I	−0.42	−0.20	+0.20	−0.89	+0.91	+0.18	+0.12	+0.69	−0.42	−2.4	−1.0
Mar. 1	Leiden	71 Tauri	I	−0.84	−0.55	−0.01	−0.59	+0.59	+0.02	+0.15	+0.50	−0.81	−4.2	−1.4
1	Leiden	70 Tauri	EB	+0.80	+0.59	+0.01	+0.64	−0.64	−0.03	−0.14	−0.55	+0.77	−4.5	−7.0
1	Leiden	θ^2 Tauri	I	−1.04	−0.68	0.00	−0.07	+0.07	−0.08	+0.16	+0.04	−1.00	−4.7	−1.3
1	Leiden	θ^2 Tauri	EB	+1.03	+0.68	0.00	−0.09	+0.09	+0.10	−0.17	+0.12	+1.00	+2.8	−0.4
1	Leiden	264 B. Tauri	I	−0.56	−0.36	+0.03	+0.84	−0.84	−0.18	+0.07	−0.79	−0.53	−2.3	−0.5
1	Leiden	θ^1 Tauri	I	−1.00	−0.65	+0.01	+0.27	−0.27	−0.14	+0.16	−0.29	−0.96	−2.1	+1.2
1	Leiden	θ^1 Tauri	EB	+1.00	+0.66	+0.01	+0.26	−0.26	+0.04	−0.17	−0.20	+0.97	+3.5	+0.4
1	Leiden	85 Tauri	I	−0.84	−0.55	−0.02	−0. 8	+0.58	+0.02	+0.15	+0.51	−0.81	−4.3	−1.5
1	Göttingen	264 B. Tauri	I	−0.58	−0.38	+0.03	+0.83	−0.83	−0.19	+0.08	−0.78	−0.56	−2.0	−0.1
1	Göttingen	85 Tauri	I	−0.84	−0.55	−0.02	−0.59	+0.59	+0.01	+0.14	+0.52	−0.81	−4.0	−1.2
1	Göttingen	θ^1 Tauri	I	−1.01	−0.66	+0.01	+0.23	−0.23	−0.13	+0.15	−0.24	−0.97	−3.0	+0.3
1	Göttingen	θ^2 Tauri	I	−1.03	−0.67	0.00	−0.12	+0.12	−0.07	+0.17	+0.07	−0.99	−3.0	+0.4
1	Greenwich	θ^2 Tauri	I	−1.04	−0.68	0.00	−0.09	+0.09	−0.07	+0.18	+0.04	−1.00	−3.0	+0.4
1	Greenwich	θ^1 Tauri	I	−1.00	−0.66	+0.01	+0.26	−0.26	−0.13	+0.16	−0.27	−0.97	−2.6	+0.7
28	Leiden	γ Tauri	I	−1.01	−0.58	0.00	+0.20	−0.20	−0.12	+0.19	−0.21	−0.87	−3.8	−0.6
Apr. 4	Cape	χ Leonis	I	−0.99	−0.73	−0.41	+0.07	+0.41	−0.26	−0.25	+0.10	−0.51	−2.0	+1.2
May 4	Greenwich	l Virginis	I	−1.04	−0.33	−0.01	+0.01	+0.02	−0.10	−0.31	+0.11	−0.45	−2.7	+0.6
4	Leiden	l Virginis	I	−1.03	−0.33	+0.06	−0.07	−0.09	−0.06	−0.33	0.00	−0.45	−0.7	+2.6
22	Washington	α Tauri	I	−0.96	−0.48	−0.06	−0.47	+0.47	−0.06	+0.15	+0.39	−0.17	−1.3	+1.7
27	Greenwich	18 Leonis	I	−1.04	−0.94	−0.05	−0.28	+0.29	−0.22	−0.23	+0.16	−0.93	−4.1	−0.8
June 24	Washington	49 Leonis	I	−0.69	−0.59	−0.77	+0.09	+0.78	−0.31	−0.14	+0.30	−0.53	−0.8	+1.1
July 1	Washington	24 Scorpii	I	−0.75	+0.28	−0.11	−0.61	−0.62	+0.09	+0.15	+0.53	−0.53	−1.1	+1.2
Aug. 9	Cape	ξ^1 Ceti	IB	−0.91	+0.13	+0.13	−0.29	+0.32	+0.07	+0.30	+0.09	+0.93	−0.1	+2.7
Sept. 4	Leiden	33 Ceti	IB	−0.93	+0.50	+0.10	−0.12	+0.15	+0.05	+0.33	−0.03	+0.58	−4.1	−1.2
6	Leiden	μ Ceti	IB	−0.69	+0.05	−0.18	+0.68	−0.70	−0.22	+0.17	−0.50	+0.62	+4.7	+6.8
7	Radcliffe	f Tauri	IB	−0.78	−0.13	−0.38	+0.46	−0.60	−0.17	+0.18	−0.52	+0.76	−2.6	−0.2
8	Radcliffe	θ^2 Tauri	IB	−0.97	−0.36	+0.06	+0.28	−0.29	−0.12	+0.17	−0.32	+0.96	−2.8	+0.2
8	Radcliffe	θ^1 Tauri	IB	−0.78	−0.28	+0.13	+0.63	−0.64	−0.16	+0.13	−0.63	+0.77	−0.5	+1.9
8	Leiden	71 Tauri	IB	−0.99	−0.37	−0.03	−0.15	+0.15	−0.03	+0.20	+0.08	+0.99	−5.3	−2.2
8	Leiden	71 Tauri	E	+0.95	+0.35	−0.06	−0.31	+0.32	+0.11	−0.15	+0.35	−0.95	+2.3	−0.5
8	Leiden	θ^2 Tauri	IB	−0.98	−0.36	+0.04	+0.22	−0.22	−0.11	+0.18	−0.26	+0.97	−2.4	+0.6
8	Leiden	264 B. Tauri	I	−0.47	−0.17	+0.18	+0.86	−0.88	−0.17	+0.07	−0.83	+0.47	−2.7	−1.3
8	Leiden	264 B. Tauri	E	+0.66	+0.24	+0.16	+0.74	−0.76	−0.09	−0.13	−0.66	−0.66	+0.9	−1.0
8	Leiden	85 Tauri	E	+0.60	+0.22	−0.17	−0.79	+0.81	+0.18	−0.09	+0.77	−0.59	+2.4	+0.6
8	Leiden	α Tauri	IB	−0.58	−0.21	+0.19	+0.79	−0.82	−0.18	+0.09	−0.78	+0.57	−1.5	+0.2
8	Leiden	α Tauri	E	+0.67	+0.25	+0.18	+0.73	−0.75	−0.09	−0.12	−0.67	−0.67	+0.4	−1.5
8	Göttingen	α Tauri	IB	−0.68	−0.25	+0.17	+0.72	−0.74	−0.17	+0.11	−0.71	+0.67	−2.6	−0.5
8	Göttingen	α Tauri	E	+0.73	+0.27	+0.16	+0.67	−0.69	−0.07	−0.14	−0.63	−0.72	+0.9	−1.2
9	Leiden	115 Tauri	E	+0.86	+0.47	+0.24	+0.51	−0.56	+0.02	−0.09	−0.50	−0.82	+1.8	−0.7
9	Radcliffe	111 Tauri	IB	−0.42	−0.23	−0.38	−0.83	+0.91	+0.07	+0.05	+0.87	+0.90	−4.3	−3.0
28	Washington	64 Aquarii	I	−0.35	+0.38	−0.90	+0.19	−0.92	−0.24	+0.08	+0.36	−0.23	−0.6	+0.5
1869, Jan. 23	Leiden	θ^1 Tauri	EB	+0.90	+0.06	−0.15	−0.45	+0.48	+0.16	−0.16	+0.49	+0.58	−4.1	−6.5
23	Leiden	θ^2 Tauri	EB	+0.61	+0.04	−0.26	−0.76	+0.81	+0.21	−0.10	+0.77	+0.39	−0.7	−2.3

GROUP XI—1857-1873—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1869, Jan. 23	Leiden	264 B. Tauri	I	−1.02	−0.07	+0.01	+0.04	−0.04	−0.09	+0.19	+0.49	−0.66	−4.7	−1.8
23	Vienna	θ^1 Tauri	I	−0.77	−0.05	−0.20	−0.62	+0.65	+0.07	+0.18	+0.54	−0.50	−4.7	−2.5
23	Vienna	264 B. Tauri	I	−0.97	−0.07	−0.11	−0.31	+0.33	−0.02	+0.19	+0.25	−0.63	−0.8	+2.0
23	Vienna	α Tauri	I	−0.97	−0.07	−0.11	−0.29	+0.31	−0.02	+0.17	+0.24	−0.63	−0.9	+1.9
24	Leiden	119 Tauri	I	−0.74	−0.21	+0.40	+0.60	−0.72	−0.17	+0.08	−0.42	−0.34	−2.8	−0.7
24	Leiden	120 Tauri	I	−0.99	−0.28	+0.20	+0.30	−0.36	−0.15	+0.11	−0.75	−0.46	−3.9	−1.0
24	Greenwich	120 Tauri	I	−0.99	−0.28	+0.20	+0.30	−0.36	−0.15	+0.10	−0.42	−0.46	−3.5	−0.6
24	Greenwich	119 Tauri	I	−0.73	−0.20	−0.41	−0.61	+0.73	−0.16	+0.07	−0.77	−0.33	−3.3	−1.2
24	Radcliffe	119 Tauri	I	−0.70	−0.28	+0.43	+0.62	−0.75	−0.16	+0.07	−0.78	−0.32	−4.0	−2.0
24	Radcliffe	119 Tauri	EB	+0.80	+0.32	+0.38	+0.55	−0.67	+0.03	−0.09	−0.61	+0.37	−1.5	−3.7
28	Washington	α Leonis	E	+1.09	+0.94	+0.31	−0.06	−0.37	+0.28	+0.25	−0.13	−0.32	+2.5	−0.4
Feb. 15	Washington	29 Ceti	I	−0.91	+0.75	0.00	0.00	+0.01	+0.04	+0.33	−0.07	−0.81	−3.4	−0.9
15	Washington	33 Ceti	I	−0.74	+0.62	−0.29	+0.49	−0.58	−0.17	+0.25	−0.21	−0.66	−1.4	+0.7
19	Washington	75 Tauri	I	−0.96	−0.05	−0.08	−0.21	+0.22	0.00	+0.19	+0.15	−0.94	−1.6	+1.1
Mar. 23	Cape	δ Cancri	I	−0.77	−0.58	+0.70	+0.09	−0.71	−0.01	−0.13	−0.53	−0.36	−1.7	+0.4
23	Cape	δ Cancri	EB	+0.50	+0.37	+0.89	+0.10	−0.89	+0.22	+0.06	−0.74	+0.23	+1.4	+0.1
Apr. 16	Vienna	119 Tauri	I	−0.73	−0.16	−0.43	−0.53	+0.68	+0.03	+0.09	+0.61	−0.66	−3.5	−1.5
May 18	Leipzig	α Leonis	I	−0.52	−0.46	−0.84	+0.25	+0.87	−0.29	−0.09	+0.44	−0.48	−1.1	+0.3
18	Kremsmunster	α Leonis	I	−0.42	−0.37	−0.88	+0.27	+0.92	−0.30	−0.07	+0.47	−0.39	−3.7	−2.6
18	Kremsmunster	α Leonis	EB	+0.57	+0.50	−0.81	+0.25	+0.85	−0.15	+0.18	+0.47	+0.53	+1.1	−0.3
Aug 2	Göttingen	α Tauri	E	+0.90	+0.19	−0.20	−0.33	+0.39	+0.10	−0.17	+0.42	−0.76	+6.6	+4.4
2	Greenwich	α Tauri	E	+0.94	+0.20	−0.14	−0.25	+0.29	+0.10	−0.19	+0.35	−0.80	+5.1	+2.9
2	Radcliffe	α Tauri	E	+0.94	+0.20	−0.14	−0.23	+0.27	+0.09	−0.19	+0.33	−0.80	+4.2	+2.0
13	Radcliffe	13 Libræ	I	−0.42	−0.35	−0.11	−0.88	−0.89	+0.27	−0.18	+0.58	−0.07	+0.5	+1.6
19	Cape	ρ Capricor.	I	0.00	0.00	−1.00	−0.04	−1.00	−0.13	−0.01	+0.84	0.00	−1.3	−1.3
19	Cape	ρ Capricor.	EB	+0.27	−0.14	−0.96	−0.04	−0.96	−0.12	−0.05	+0.82	+0.14	−2.5	−3.1
29	Cape	δ Tauri	IB	−0.95	+0.31	+0.02	+0.03	−0.04	−0.03	+0.20	−0.07	+0.99	−3.5	−1.1
29	Cape	δ Tauri	E	+0.91	−0.30	−0.13	−0.24	+0.27	+0.08	−0.20	+0.29	−0.95	+1.9	−0.3
Nov. 10	Radcliffe	30 Capricor.	I	−0.62	+0.36	+0.73	−0.16	+0.75	+0.15	+0.16	−0.58	−0.66	−3.6	−2.1
17	Madrid	μ Ceti	I	−0.88	+0.82	−0.04	−0.28	+0.28	+0.10	+0.33	+0.09	−0.24	+0.2	+2.3
17	Madrid	μ Ceti	EB	+0.74	−0.68	−0.09	−0.59	+0.60	+0.19	−0.23	+0.46	+0.20	−2.1	−3.7
Dec. 8	Göttingen	δ Capricor.	I	−0.76	+0.45	−0.55	+0.21	−0.59	−0.15	+0.18	+0.30	−0.70	−6.5	−4.7
14	Greenwich	ξ^2 Ceti	I	−0.67	+0.68	−0.07	−0.66	+0.66	+0.25	+0.30	+0.31	−0.54	−3.5	−1.9
14	Radcliffe	ξ^2 Ceti	EB	+0.91	−0.90	0.00	+0.02	−0.02	−0.02	−0.33	+0.09	+0.71	+7.6	+5.7
1870, Jan. 5	Washington	182 B. Aquarii	I	−0.72	+0.55	−0.53	+0.52	−0.64	−0.19	+0.20	+0.23	−0.53	−1.0	+0.7
Feb. 7	Washington	μ Ceti	I	−0.90	+0.90	−0.02	−0.08	+0.08	+0.05	+0.33	−0.04	−1.00	−1.5	+0.5
9	Leiden	63 Tauri	I	−0.93	+0.60	+0.05	+0.06	−0.08	−0.03	+0.22	−0.16	−0.93	−2.3	−0.3
10	Leiden	m Tauri	I	−0.56	+0.26	−0.61	−0.53	+0.81	+0.12	+0.11	+0.74	−0.51	+7.0	+8.2
10	Göttingen	m Tauri	I	−0.54	+0.25	−0.62	−0.54	+0.82	+0.13	+0.10	+0.84	−0.49	−1.4	−0.2
10	Greenwich	m Tauri	I	−0.51	+0.24	−0.63	−0.55	+0.84	+0.13	+0.10	+0.77	−0.46	−0.7	+0.4
11	Leiden	χ^2 Orionis	I	−0.31	+0.07	−0.84	−0.44	+0.95	+0.06	+0.03	+0.92	−0.22	−1.5	−0.8
11	Leiden	χ^2 Orionis	EB	+0.42	−0.07	−0.80	−0.42	+0.90	+0.08	−0.02	+0.93	+0.30	−4.9	−5.8
11	Radcliffe	χ^2 Orionis	I	−0.08	+0.02	−0.88	−0.47	+1.00	+0.07	+0.01	+0.99	−0.06	−0.6	−0.4
11	Radcliffe	χ^2 Orionis	EB	+0.19	−0.04	−0.86	−0.46	+0.98	+0.09	−0.01	+0.99	+0.14	−3.7	−4.1
12	Washington	ζ Geminor.	I	−0.30	−0.29	−0.92	−0.25	+0.95	−0.03	0.00	+0.89	−0.17	−0.9	−0.2
22	Cape	24 Scorpii	IB	−0.69	−0.48	−0.51	−0.56	−0.75	+0.06	−0.16	+0.65	+0.66	+0.1	+1.6
22	Cape	24 Scorpii	E	+0.42	+0.30	−0.62	−0.67	−0.92	+0.23	+0.04	+0.89	−0.41	+1.3	+0.5
Mar. 10	Cape	ζ Tauri	IB	−0.88	+0.32	−0.32	−0.21	+0.38	+0.02	+0.12	+0.34	−0.90	+1.3	+3.2
10	Washington	χ^1 Orionis	I	−0.37	+0.13	−0.81	−0.43	+0.92	+0.07	+0.04	+0.89	−0.38	−2.8	−2.0
10	Washington	χ^1 Orionis	EB	+0.57	−0.20	−0.71	−0.38	+0.81	+0.09	−0.05	+0.85	+0.57	−0.7	−1.8
23	Cape	15 Sagittarii	E	+0.72	+0.36	−0.64	−0.28	−0.70	+0.11	+0.04	+0.03	−0.70	+1.7	+0.3
June 16	Leipzig	η Capricor.	IB	−0.89	+0.04	+0.45	−0.17	+0.48	+0.01	+0.18	−0.43	+0.56	−8.2	−6.5
July 10	Leiden	158 G. Ophiuchi	I	−1.04	−0.66	−0.27	−0.13	−0.30	−0.12	−0.13	+0.20	−0.45	−0.7	+1.3
Aug. 9	Radcliffe	4 Capricor.	I	−0.61	−0.14	+0.78	−0.17	+0.80	+0.04	+0.08	−0.74	−0.23	−5.2	−4.0
17	Leiden	μ Ceti	IB	−0.82	+0.91	+0.16	+0.38	−0.41	−0.12	+0.29	−0.35	+0.88	−1.9	−0.3
17	Greenwich	μ Ceti	E	+0.85	−0.94	+0.13	+0.31	−0.34	−0.03	−0.34	−0.11	−0.90	+2.2	+0.8
19	Greenwich	64 Tauri	E	+0.73	−0.70	+0.44	+0.40	−0.60	−0.14	−0.20	−0.47	−0.78	+1.1	−0.1
Sept. 6	Washington	η Capricor.	I	−0.78	−0.08	+0.56	−0.26	+0.62	+0.06	+0.17	−0.48	−0.51	−3.5	−2.1
7	Cape	δ Capricor.	I	−0.96	+0.07	+0.16	−0.11	+0.20	−0.02	+0.26	−0.14	−0.52	−1.7	0.0
7	Cape	δ Capricor.	EB	+0.82	−0.06	+0.44	−0.32	+0.54	+0.18	−0.19	−0.35	+0.45	−0.8	−2.2
16	Greenwich	i Tauri	E	+0.91	−0.85	+0.01	+0.01	−0.01	−0.01	−0.20	+0.09	−0.98	+3.4	+1.9
28	Cape	γ Libræ	I	−0.67	−0.60	−0.50	−0.62	−0.80	+0.11	−0.22	+0.58	−0.41	+0.4	+1.6
28	Cape	γ Libræ	EB	+0.77	+0.68	−0.46	−0.56	−0.73	+0.35	+0.16	+0.65	+0.46	−3.5	−4.7
Oct. 1	Radcliffe	117 B. Sagittarii	I	−0.85	−0.57	+0.57	+0.08	+0.58	−0.08	+0.03	−0.58	−0.82	−3.2	−1.7
1	Greenwich	117 B. Sagittarii	I	−0.89	−0.59	+0.51	+0.07	+0.52	−0.13	−0.03	−0.58	−0.84	−3.9	−2.3
14	Greenwich	ζ Tauri	IB	−0.91	−0.75	+0.04	+0.01	−0.04	0.00	+0.13	−0.12	+0.90	−5.9	−4.3
14	Greenwich	ζ Tauri	E	+0.91	+0.75	+0.03	+0.01	−0.03	−0.01	−0.13	+0.04	−0.90	+7.2	+5.8
Nov. 9	Radcliffe	68 Tauri	IB	−0.64	−0.27	−0.56	−0.42	+0.70	+0.18	+0.19	+0.57	+0.26	−5.5	−4.4
9	Radcliffe	68 Tauri	E	+0.46	+0.19	−0.53	−0.68	+0.86	+0.18	−0.10	+0.82	−0.18	−7.0	−7.7
Dec. 27	Cape	ψ^1 Aquarii	I	−0.92	+0.21	−0.14	+0.29	−0.32	−0.16	+0.31	0.00	−0.84	−0.7	+0.8

GROUP XI—1857-1873—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1870, Dec. 27	Cape	ψ^2 Aquarii	I	−0.35	+0.08	+0.39	−0.85	+0.93	+0.31	+0.19	+0.27	−0.32	−0.9	−0.3
1871, Jan. 11	Leiden	ν Virginis	IB	−1.01	−0.50	+0.04	−0.11	−0.12	−0.05	−0.38	−0.10	+0.90	−3.2	−1.6
11	Leiden	ν Virginis	E	+1.02	+0.50	+0.03	−0.09	−0.10	+0.14	+0.34	+0.07	−0.90	+0.9	−0.5
Feb. 1	Cape	1 Geminor.	I	−0.92	+0.82	+0.12	+0.02	−0.12	−0.01	+0.10	−1.00	−0.63	−0.5	+1.0
1	Cape	1 Geminor.	EB	+0.92	−0.83	0.00	0.00	0.00	+0.01	−0.09	+1.00	+0.64	−1.1	−2.3
28	Washington	141 Tauri	I	−0.85	+0.80	+0.37	+0.05	−0.37	−0.03	+0.07	−0.44	−0.86	+1.0	+2.3
Mar. 3	Greenwich	η Cancri	I	−0.86	+0.32	−0.43	+0.22	+0.48	−0.12	−0.17	+0.33	−0.46	+0.3	+1.6
3	Greenwich	39 Cancri	I	−0.97	+0.36	−0.11	+0.06	+0.13	−0.09	−0.16	+0.04	−0.51	−1.7	−0.3
May 5	Cape	θ Libræ	E	+1.04	+0.88	−0.36	−0.25	−0.44	+0.35	+0.23	+0.43	−0.22	+1.1	−0.1
June 29	Cape	θ Libræ	I	−1.06	−0.93	−0.27	−0.18	−0.33	−0.11	−0.30	+0.22	−0.55	−0.8	+0.5
29	Washington	ν Scorpii	I	−0.98	−0.85	+0.44	+0.24	+0.50	−0.31	−0.22	−0.52	−0.50	−2.3	−1.1
Sept. 7	Washington	3 Geminor.	E	+0.87	−0.96	−0.26	+0.02	+0.26	+0.01	−0.08	+0.34	−0.93	+0.4	−0.5
22	Washington	χ Sagittarii	I	−0.81	−0.72	−0.60	+0.24	−0.65	−0.15	+0.06	+0.59	−0.75	−0.8	+0.1
27	Washington	33 Piscium	EB	+0.94	+0.07	−0.01	−0.36	+0.35	+0.22	−0.34	+0.07	+0.25	−2.2	−3.0
Oct. 3	Washington	ι Tauri	IB	−0.90	+0.98	−0.06	+0.01	+0.07	+0.02	+0.21	−0.06	+0.87	−2.7	−1.7
3	Washington	ι Tauri	E	+0.84	−0.91	−0.36	+0.06	+0.36	+0.06	−0.19	+0.45	−0.81	+1.0	+0.2
21	Washington	χ Capricor.	I	−1.03	−0.75	−0.14	+0.15	−0.20	−0.18	+0.21	+0.08	−0.97	+0.9	+1.9
23	Greenwich	69 Aquarii	I	−0.55	−0.24	+0.80	−0.26	+0.84	+0.23	+0.24	−0.38	−0.48	−0.2	+0.3
23	Greenwich	τ Aquarii	I	−1.01	−0.44	+0.07	−0.02	+0.07	−0.08	+0.36	−0.12	−0.87	−0.3	+0.7
23	Leiden	69 Aquarii	I	−0.35	−0.15	+0.29	−0.90	+0.94	+0.27	+0.17	−0.40	−0.29	+1.2	+1.6
23	Leiden	69 Aquarii	EB	+0.15	+0.06	+0.30	−0.94	+0.99	+0.35	+0.01	−0.36	+0.12	+2.7	+2.6
23	Leiden	τ Aquarii	I	−1.01	−0.44	+0.04	−1.14	+0.15	−0.06	+0.37	−0.16	−0.80	+0.5	+1.5
23	Leiden	τ Aquarii	EB	+0.92	+0.40	+0.12	−0.40	+0.42	+0.24	−0.30	−0.08	+0.79	−5.4	−6.2
23	Radcliffe	69 Aquarii	I	−0.61	−0.26	+0.21	−0.78	+0.80	+0.20	+0.26	−0.37	−0.52	−4.3	−3.7
23	Radcliffe	τ Aquarii	I	−1.02	−0.44	+0.01	−0.04	+0.04	−0.10	+0.36	−0.11	−0.87	−0.4	+0.6
23	Radcliffe	τ Aquarii	EB	+0.96	+0.42	+0.08	−0.31	+0.32	+0.21	−0.32	−0.03	−0.83	−3.6	−4.4
27	Washington	64 Ceti	I	−0.54	+0.27	+0.50	+0.66	−0.83	−0.35	+0.15	−0.49	−0.09	−1.5	−1.0
Nov. 15	Radcliffe	λ Sagittarii	I	−1.12	−1.00	+0.08	−0.02	+0.08	−0.22	−0.05	−0.17	−0.65	−0.2	+0.9
18	Radcliffe	ε Capricor.	I	−0.50	−0.36	−0.48	+0.74	−0.88	−0.29	+0.09	+0.53	−0.47	+0.2	+0.7
18	Leipzig	ε Capricor.	I	−0.81	−0.58	−0.35	+0.52	−0.63	−0.27	+0.19	+0.35	−0.76	+0.2	+1.0
18	Altona	ε Capricor.	I	−0.71	−0.50	−0.41	+0.61	−0.74	−0.28	+0.16	+0.44	−0.66	−0.1	0.6
27	Radcliffe	ι Tauri	IB	−0.90	+0.94	−0.17	−0.02	+0.17	+0.03	+0.21	+0.06	+0.40	−6.2	−5.3
Dec. 1	Radcliffe	γ Cancri	IB	−0.90	−0.77	+0.08	−0.08	−0.11	+0.02	−0.19	−0.17	−0.81	+1.5	+2.4
1	Radcliffe	γ Cancri	E	+0.85	−0.73	+0.27	−0.27	−0.38	+0.08	+0.17	−0.23	+0.45	−3.4	−4.0
18	Washington	24 B. Ceti	I	−0.96	−0.20	−0.03	−0.26	+0.27	+0.03	+0.44	−0.17	−0.97	−3.0	−2.1
20	Greenwich	ν Piscium	I	−0.51	+0.14	+0.45	+0.71	−0.84	−0.37	+0.15	−0.39	−0.51	−1.7	−1.2
20	Radcliffe	ν Piscium	I	−0.49	+0.14	+0.49	+0.71	−0.86	−0.37	+0.13	−0.39	−0.51	−1.5	−1.0
1872, Jan. 23	Radcliffe	ω Geminor.	I	−0.43	+0.47	+0.80	−0.36	−0.88	0.00	0.00	−0.90	−0.13	−1.2	−0.8
Feb. 21	Washington	γ Cancri	I	−0.33	+0.32	−0.64	+0.67	+0.93	−0.17	−0.06	+0.74	−0.15	−2.7	−2.4
21	Washington	γ Cancri	EB	+0.21	+0.21	−0.66	+0.70	+0.97	−0.17	+0.06	+0.81	+0.10	−8.5	−8.6
21	Greenwich	γ Cancri	I	−0.86	+0.84	+0.22	−0.24	−0.33	+0.06	−0.19	−0.33	−0.39	−0.9	−0.2
21	Greenwich	γ Cancri	EB	+0.74	−0.73	+0.38	−0.44	−0.58	+0.11	+0.15	−0.47	+0.34	+0.8	+0.4
Apr. 25	Washington	22 Ophiuchi	E	+1.09	+0.83	−0.15	0.00	−0.15	+0.23	+0.20	+0.21	−0.65	+0.7	+0.1
May 19	Leiden	65 Virginis	I	−0.98	−0.07	−0.18	−0.25	−0.31	+0.01	−0.43	+0.03	−0.51	−1.0	−0.4
19	Leiden	66 Virginis	I	−1.01	−0.07	−0.11	−0.14	−0.18	−0.04	−0.43	+0.01	−0.53	−0.5	+0.1
19	Greenwich	65 Virginis	I	−1.01	−0.07	−0.10	−0.15	−0.18	−0.05	−0.44	−0.02	−0.53	−0.8	−0.2
19	Greenwich	66 Virginis	I	−1.03	−0.07	+0.03	−0.05	−0.06	−0.10	−0.42	−0.05	−0.54	−2.4	−1.8
22	Leiden	ω^1 Scorpii	IB	−1.09	−0.57	−0.17	−0.04	−0.17	−0.16	−0.29	+0.08	+0.07	−6.0	−5.3
22	Leiden	ω^2 Scorpii	IB	−1.06	−0.65	+0.28	+0.06	+0.29	−0.27	−0.25	−0.32	+0.07	−3.7	−3.1
22	Greenwich	ω^2 Scorpii	E	+1.11	+0.67	+0.13	+0.02	+0.13	+0.18	+0.29	−0.04	−0.07	−2.7	−3.2
22	Radcliffe	ω^2 Scorpii	E	+1.10	+0.67	+0.15	+0.03	+0.15	+0.17	+0.29	−0.05	−0.07	−2.4	−2.9
July 22	Greenwich	69 Aquarii	E	+1.11	+0.83	0.00	−0.08	+0.08	+0.25	−0.37	+0.05	−0.51	−1.4	−1.8
Aug. 12	Radcliffe	λ Libræ	I	−1.02	−0.59	−0.19	−0.03	−0.19	−0.07	−0.21	+0.17	−0.95	−0.4	+0.2
15	Vienna	σ Sagittarii	I	−0.99	−0.84	−0.41	+0.26	−0.49	−0.20	0.00	+0.54	−0.57	−0.6	−0.1
15	Neuchatel	σ Sagittarii	I	−1.00	−0.85	−0.38	+0.24	−0.45	−0.20	0.00	+0.46	−0.58	+2.0	+2.5
15	Leipzig	σ Sagittarii	I	−0.95	−0.81	−0.45	+0.28	−0.53	−0.19	0.00	+0.43	−0.55	−0.5	0.0
15	Leipzig	σ Sagittarii	EB	+0.98	+0.83	−0.42	+0.26	−0.50	+0.18	−0.02	+0.56	+0.56	−7.6	−8.0
15	Greenwich	σ Sagittarii	EB	+0.96	+0.82	−0.45	+0.28	−0.53	+0.19	−0.01	+0.58	+0.55	−0.4	−0.8
Sept. 15	Greenwich	69 Aquarii	I	−1.08	−0.84	+0.04	−0.26	+0.26	+0.12	+0.38	−0.17	−0.36	−0.7	−0.2
15	Greenwich	τ Aquarii	I	−1.05	−0.82	0.00	+0.35	−0.35	−0.32	+0.32	+0.06	−0.35	−1.2	−0.7
15	Radcliffe	69 Aquarii	I	−1.09	−0.84	+0.23	+0.03	+0.23	−0.13	+0.38	−0.18	−0.36	+4.3	+4.8
15	Radcliffe	τ Aquarii	I	−1.03	−0.80	−0.38	−0.05	−0.38	−0.34	+0.32	+0.07	−0.34	+4.9	+5.4
15	Radcliffe	τ Aquarii	EB	+1.12	+0.87	−0.10	−0.01	−0.10	+0.19	−0.39	+0.12	+0.37	−7.2	−7.6
21	Washington	ω Tauri	IB	−0.78	−0.22	−0.58	+0.04	+0.58	+0.08	+0.25	+0.47	+0.67	−3.7	−3.3
21	Washington	ω Tauri	E	+0.51	−0.20	−0.85	−0.04	+0.85	+0.25	−0.11	+0.80	−0.44	−2.8	−3.0
21	Washington	53 Tauri	IB	−0.81	+0.31	+0.54	+0.02	−0.54	−0.19	+0.21	−0.56	+0.71	−2.1	−1.7
24	Greenwich	ε Geminor.	IB	−0.90	+0.85	−0.13	+0.08	+0.15	−0.01	+0.02	+0.06	+0.99	−1.8	−1.4
24	Greenwich	ε Geminor.	E	+0.83	−0.79	−0.38	+0.21	+0.40	+0.01	0.00	+0.47	−0.92	+3.1	+2.8
24	Washington	37 Geminor.	E	+0.89	−0.84	+0.17	−0.12	−0.20	+0.01	0.00	−0.13	−0.65	+3.1	+2.8
Oct. 11	Radcliffe	35 Capricor.	I	−0.60	−0.54	+0.26	−0.80	−0.84	+0.11	+0.19	−0.38	−0.50	−5.5	−5.2

GROUP XI—1857–1873—Continued.

Date.		Place.	Star.		Ph.	λ	κ	iθ	i	b_0	α_0	δ_0	ε	P	n	n′
															″	″
1872, Oct.	11	Greenwich	35	Capricor.	I	−0.51	−0.47	+0.29	−0.83	+0.88	+0.15	+0.16	−0.65	−0.43	−1.9	−1.6
	14	Greenwich	33	Piscium	I	−1.05	−0.69	−0.09	−0.24	+0.26	−0.08	+0.43	−0.11	−0.50	−0.8	−0.3
	15	Washington	33	Ceti	I	−1.06	−0.45	+0.10	−0.10	−0.14	−0.23	+0.42	−0.13	−0.25	0.0	+0.5
	15	Washington		*f* Piscium	I	−1.03	−0.43	−0.18	+0.21	+0.27	−0.04	+0.45	+0.13	−0.24	−1.9	−1.4
Dec.	9	Greenwich		*f* Piscium	I	−0.60	−0.32	+0.58	+0.58	−0.81	−0.42	+0.17	−0.21	−0.54	−0.3	−0.1
	9	Radcliffe		*f* Piscium	E	+0.82	+0.43	+0.44	+0.41	−0.60	−0.16	−0.41	−0.11	+0.74	−6.3	−6.4
1873, Jan.	22	Radcliffe	28	Libræ	IB	−0.83	−0.09	−0.55	−0.09	−0.56	+0.10	−0.33	+0.37	+0.76	−2.6	−2.4
Mar.	1	Washington		*μ* Piscium	I	−1.02	−0.55	+0.29	+0.21	−0.36	−0.34	+0.37	−0.20	−0.54	+1.6	+1.9
	5	Washington	103	Tauri	I	−0.94	+0.29	−0.13	+0.04	+0.14	−0.03	+0.18	+0.06	−0.99	−1.6	−1.3
Apr.	2	Strassburg	118	Tauri (S)	I	−0.94	+0.27	+0.22	−0.10	−0.25	−0.10	+0.14	−0.31	−0.85	−4.6	−4.3
	2	Strassburg	118	Tauri (N)	I	−0.94	+0.27	+0.22	−0.11	−0.25	−0.10	+0.15	−0.31	−0.85	−1.1	−0.8
	2	Vienna	118	Tauri	I	−0.89	+0.31	+0.36	−0.17	−0.39	−0.12	+0.13	−0.46	−0.81	+0.1	+0.4
	2	Radcliffe	118	Tauri (S)	I	−0.94	+0.35	+0.22	−0.10	−0.24	−0.10	+0.14	−0.31	−0.85	−7.1	−6.8
	2	Radcliffe	118	Tauri (N)	I	−0.94	+0.35	+0.22	−0.10	−0.24	−0.10	+0.14	−0.31	−0.85	−8.7	−8.4
	30	Nikolaieff	139	Tauri	I	−0.90	+0.38	+0.32	−0.21	−0.39	−0.12	+0.08	−0.45	−0.64	−0.6	−0.3
May	1	Greenwich	39	Geminor.	I	−0.93	+0.59	−0.10	+0.11	+0.15	−0.06	−0.03	+0.07	−0.82	−2.3	−2.0
	1	Nikolaieff	39	Geminor.	I	−0.90	+0.57	+0.22	−0.23	−0.30	−0.04	−0.02	−0.38	−0.79	−0.4	−0.1
	1	Nikolaieff	40	Geminor.	I	−0.92	+0.58	−0.16	+0.22	+0.24	−0.05	−0.02	+0.15	−0.80	−0.7	−0.4
	5	Nikolaieff	42	Leonis	I	−0.79	+0.88	+0.04	+0.47	+0.47	−0.17	−0.30	+0.20	−0.84	−0.6	−0.4
	11	Nikolaieff	8	Libræ	I	−0.92	+0.24	+0.36	+0.08	+0.37	−0.22	−0.24	−0.32	−0.06	+0.6	+0.8
	11	Nikolaieff		*α* Libræ	I	−0.90	+0.23	+0.41	+0.09	+0.41	−0.24	−0.32	−0.34	−0.05	0.0	+0.2
	11	Nikolaieff		*α* Libræ	EB	+0.98	−0.26	+0.08	+0.02	+0.08	+0.06	+0.40	+0.01	+0.05	0.0	0.0
	16	Nikolaieff		*ω* Sagittarii	E	+0.98	+0.75	−0.20	+0.35	−0.40	+0.12	−0.13	+0.44	−0.81	−1.3	−1.3
June	5	Nikolaieff	46	Virginis	I	−0.67	+0.51	−0.53	−0.44	−0.69	+0.29	−0.41	+0.12	−0.59	−0.5	−0.5
July	1	Nikolaieff		*b* Virginis	I	−0.73	+0.74	+0.34	+0.48	+0.59	−0.26	−0.29	−0.01	−0.80	−1.0	−0.8
	2	Nikolaieff		*γ* Virginis	EB	+0.91	−0.81	+0.04	+0.04	+0.06	−0.01	+0.44	+0.04	+1.00	+3.1	+3.0
	4	Greenwich		*λ* Virginis	I	−0.71	+0.29	+0.65	+0.19	+0.68	−0.32	−0.18	−0.42	−0.60	+1.7	+1.9
	4	Radcliffe		*λ* Virginis	I	−0.69	+0.32	+0.65	+0.20	+0.68	−0.31	−0.24	−0.44	−0.65	+1.3	+1.5
	19	Nikolaieff		*κ* Tauri	E	+0.82	+0.14	+0.53	−0.15	−0.55	−0.06	−0.24	−0.43	−0.71	−0.5	−0.4
	19	Nikolaieff	67	Tauri	E	+0.97	+0.16	+0.18	−0.05	−0.18	+0.04	−0.26	−0.10	−0.10	+0.1	+0.2
Aug.	6	Washington		*ω* Sagittarii	I	−1.12	−0.74	−0.01	+0.04	−0.03	−0.23	+0.13	−0.04	−0.31	−0.6	−0.4
	6	Washington		*A* Sagittarii	I	−1.12	−0.74	+0.02	−0.04	+0.04	−0.22	+0.15	−0.10	−0.31	−0.7	−0.5
	9	Greenwich		*τ* Aquarii	IB	−1.04	−0.90	+0.13	+0.42	−0.44	−0.41	+0.32	+0.11	+0.27	−2.2	−2.0
	9	Nikolaieff		*τ* Aquarii	IB	−1.15	−1.00	0.00	−0.01	+0.01	−0.26	+0.41	−0.08	+0.32	−1.6	−1.4
	9	Nikolaieff		*τ* Aquarii	E	+0.48	+0.42	+0.28	+0.86	−0.91	−0.24	−0.24	+0.39	−0.13	−1.5	−1.5
	10	Nikolaieff	376	B. Aquarii	E	+1.10	+0.94	+0.15	+0.22	−0.27	+0.12	−0.47	+0.11	−0.51	+1.8	+1.9
	11	Nikolaieff	15	Ceti	E	+1.12	+0.93	−0.03	−0.03	+0.04	+0.24	−0.44	−0.07	−0.79	−0.6	−0.5
	12	Nikolaieff		*μ* Piscium	E	+0.98	+0.75	+0.38	+0.20	−0.43	−0.02	−0.44	−0.08	−0.75	+1.0	+1.1
	18	Nikolaieff	39	Geminor.	E	+0.92	−0.41	−0.10	+0.12	+0.16	+0.04	+0.22	+0.22	−0.77	−1.0	−0.9
Oct.	3	Greenwich		*τ* Aquarii	I	−1.01	−0.87	+0.16	+0.44	−0.47	−0.41	+0.31	+0.12	−0.51	+0.2	+0.4
	3	Nikolaieff		*τ* Aquarii	I	−1.10	−0.96	−0.09	−0.24	+0.25	−0.14	+0.42	−0.18	−0.56	−0.6	−0.4
	3	Radcliffe	69	Aquarii	I	−1.10	−0.96	−0.10	−0.24	+0.26	−0.14	+0.41	−0.18	−0.56	0.0	+0.2
	9	Nikolaieff		*υ* Tauri	E	+0.27	+0.09	−0.91	+0.33	+0.97	+0.27	−0.03	+0.90	−0.17	+1.9	+1.9
	9	Nikolaieff	72	Tauri	E	+0.70	+0.22	−0.70	+0.26	+0.74	+0.29	−0.15	+0.73	−0.43	+0.9	+1.0
	13	Greenwich		*λ* Cancri	E	+0.64	−0.41	−0.20	+0.69	+0.72	−0.10	+0.15	+0.66	+0.69	+1.0	+1.1
Dec.	1	Greenwich		*o* Arietis	I	−0.97	−0.62	+0.45	+0.01	−0.45	−0.35	+0.31	−0.27	−0.46	−1.4	−1.2
	24	Greenwich		*τ* Aquarii	I	−0.95	−0.84	−0.20	−0.43	+0.47	+0.02	+0.40	−0.24	−0.79	+0.1	+0.3
	24	Greenwich		*τ* Aquarii	EB	+0.76	+0.66	−0.30	−0.64	+0.71	+0.42	−0.23	−0.24	+0.63	−1.3	−1.1
	24	Radcliffe		*τ* Aquarii	I	−0.99	−0.86	−0.16	−0.39	+0.42	−0.02	+0.40	−0.24	−0.82	−0.3	−0.1

GROUP XII—1874–1890.

Date.		Place.	Star.		Ph.	λ	κ	iθ	i	b_0	α_0	δ_0	ε	P	n	n′
1874, Jan.	25	Greenwich	53	Arietis	I	−0.89	−0.63	+0.50	−0.07	−0.51	−0.31	+0.28	−0.45	−0.85	−0.8	−0.6
	25	Radcliffe	53	Arietis	I	−0.88	−0.62	+0.51	−0.06	−0.52	−0.30	+0.27	−0.43	−0.84	+0.2	+0.4
	26	Radcliffe		*A* Tauri	I	−0.97	−0.51	−0.31	+0.11	+0.33	−0.05	+0.28	+0.22	−0.88	−1.6	−1.4
	27	Radcliffe		*k* Tauri	I	−1.00	−0.36	−0.07	+0.04	+0.08	−0.10	+0.19	+0.03	−0.84	−2.4	−2.2
	27	Greenwich		*k* Tauri	I	−1.00	−0.36	−0.08	+0.06	+0.10	−0.10	+0.19	+0.01	−0.86	−1.6	−1.4
	30	Greenwich		*c* Geminor.	I	−0.65	+0.16	+0.25	−0.70	−0.74	+0.03	−0.09	−0.72	−0.27	−1.0	−0.9
	30	Radcliffe		*c* Geminor.	I	−0.61	+0.15	+0.24	−0.73	−0.77	+0.05	−0.09	−0.75	−0.26	+0.2	+0.3
Mar.	26	Radcliffe		*λ* Cancri	I	−0.55	+0.17	−0.10	+0.80	+0.81	−0.18	−0.10	+0.67	−0.55	−0.1	0.0
	26	Greenwich		*λ* Cancri	I	−0.57	+0.18	−0.10	+0.78	+0.79	−0.19	−0.11	+0.67	−0.57	+0.1	+0.2
	31	Greenwich	10	Virginis	I	−0.88	+0.97	−0.15	−0.12	−0.19	+0.08	−0.47	−0.05	−0.20	−0.6	−0.4
Apr.	22	Radcliffe		*ω* Cancri	I	−0.81	+0.15	+0.09	−0.54	−0.55	+0.01	−0.16	−0.53	−0.81	−2.3	−2.1
	22	Radcliffe	4	Cancri	I	−0.89	+0.17	−0.06	+0.35	+0.36	−0.12	−0.16	+0.28	−0.90	−4.4	−4.2
May	19	Greenwich		*c* Geminor.	I	−0.74	+0.04	+0.15	−0.66	−0.68	−0.01	−0.12	−0.66	−0.54	+1.9	+2.0
July	8	Greenwich	53	Arietis	E	+1.00	+0.83	−0.35	+0.10	+0.36	+0.30	−0.31	+0.34	−0.81	−2.0	−1.8
Aug.	20	Washington		*α* Scorpii	I	−0.87	+0.63	+0.28	−0.20	+0.34	−0.09	−0.23	−0.36	−0.91	+1.7	+1.9

GROUP XII—1874-1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													"	"
1874, Aug. 31	Strassburg	29 Arietis	E	+0.92	+0.84	−0.54	+0.09	+0.55	+0.49	−0.29	+0.39	−0.71	−4.5	−4.3
Oct. 22	Greenwich	27 Piscium	I	−1.06	−0.84	+0.30	+0.17	−0.35	−0.40	+0.40	−0.01	−0.46	−0.5	−0.3
22	Greenwich	29 Piscium	I	−1.07	−0.85	+0.28	+0.15	−0.32	−0.40	+0.40	−0.03	−0.47	+0.8	+1.0
25	Strassburg	π Arietis	IB	−1.16	−0.98	−0.06	+0.02	+0.06	−0.26	+0.40	0.00	+0.14	−2.0	−1.8
25	Strassburg	π Arietis	E	+1.14	+0.97	−0.14	+0.04	+0.14	+0.30	−0.38	+0.13	−0.14	−3.6	−3.4
Nov. 19	Greenwich	10 Ceti	I	−0.75	−0.62	−0.70	−0.25	+0.74	+0.19	+0.40	+0.01	−0.50	−2.0	−1.8
Dec. 16	Radcliffe	29 Piscium	I	−0.89	−0.72	+0.49	+0.23	−0.54	−0.40	+0.33	−0.01	−0.82	−1.5	−1.3
19	Radcliffe	π Arietis	I	−1.06	−0.94	−0.28	+0.10	+0.30	−0.11	+0.39	+0.31	−0.65	+0.2	+0.4
19	Greenwich	π Arietis	I	−1.05	−0.94	−0.31	+0.11	+0.33	−0.10	+0.39	+0.18	−0.65	+4.4	+4.6
19	Washington	45 Arietis	I	−0.97	−0.86	+0.46	+0.18	−0.50	−0.37	+0.29	−0.39	−0.59	−0.2	0.0
1875, Jan. 16	Radcliffe	63 Arietis	I	−1.06	−0.94	+0.17	−0.09	−0.19	−0.26	+0.32	−0.19	−0.86	−0.6	−0.4
20	Radcliffe	c Geminor.	I	−0.88	−0.32	0.00	+0.55	+0.55	−0.22	−0.13	+0.49	−0.19	−0.6	−0.4
30	Leipzig	31 B. Scorpii	IB	−0.75	+0.79	+0.44	−0.35	+0.56	−0.17	−0.22	−0.50	+0.78	−8.4	−8.2
Feb. 13	Leipzig	36 Tauri	I	−0.90	−0.79	+0.41	−0.36	−0.55	−0.30	+0.22	−0.49	−0.83	+1.2	+1.4
Mar. 16	Leipzig	ω Cancri	I	−1.01	−0.42	0.00	−0.02	−0.02	−0.13	−0.21	−0.04	−0.90	−0.7	−0.5
16	Leipzig	4 Cancri	I	−0.63	−0.26	+0.10	+0.78	+0.79	−0.23	−0.11	+0.71	−0.56	+0.6	+0.7
May 12	Greenwich	37 Leonis	I	−0.47	0.00	+0.60	+0.63	+0.87	−0.39	−0.12	+0.46	−0.49	−2.1	−2.0
12	Radcliffe	37 Leonis	I	−0.45	0.00	+0.61	+0.63	+0.87	−0.40	−0.13	+0.44	−0.49	−1.3	−1.2
Aug 10	Cape	σ Scorpii	I	−0.74	+0.82	−0.32	+0.47	−0.57	+0.09	−0.21	+0.51	−0.78	−0.7	−0.5
13	Washington	234 B. Sagittarii	I	−0.94	+0.67	+0.01	+0.05	−0.05	−0.07	0.14	+0.02	−0.54	−2.2	−1.9
Sept. 10	Washington	A Sagittarii	I	−0.83	+0.52	+0.14	+0.48	−0.49	−0.16	+0.17	+0.45	−0.67	0.0	+0.3
12	Vienna	33 Capricor.	I	−0.71	+0.21	−0.40	−0.55	+0.69	+0.15	+0.29	+0.40	−0.39	−2.5	−2.3
14	Washington	χ Aquarii	I	−0.92	−0.19	+0.44	+0.20	−0.49	−0.38	+0.35	+0.11	−0.07	+2.6	+2.9
14	Washington	χ Aquarii	EB	+0.94	+0.20	+0.41	+0.18	−0.45	−0.05	−0.47	+0.16	+0.07	−4.1	−4.0
Oct. 3	Washington	A Scorpii	I	−0.90	−0.77	−0.07	+0.09	−0.11	0.00	−0.28	+0.08	−0.73	−0.5	−0.2
3	Washington	3 Scorpii	I	−0.72	−0.62	−0.37	+0.47	−0.61	+0.13	−0.22	+0.53	−0.59	−1.4	−1.2
16	Greenwich	ζ Arietis	IB	−0.94	−0.78	+0.41	−0.37	−0.55	−0.38	+0.25	−0.45	+0.35	−7.4	−7.1
16	Greenwich	ζ Arietis	E	+1.08	+0.90	+0.21	−0.20	−0.29	+0.15	−0.31	−0.17	−0.40	+0.2	+0.3
20	Washington	ω Cancri	E	+0.98	+0.73	+0.10	+0.34	+0.35	+0.09	+0.22	+0.33	−0.91	−4.5	−4.4
24	Radcliffe	σ Leonis	E	+0.62	+0.04	−0.73	−0.25	−0.77	+0.42	+0.21	−0.17	−0.50	−5.1	−5.0
Nov. 8	Radcliffe	χ Aquarii	I	−0.60	−0.13	−0.77	−0.27	+0.81	+0.29	+0.37	−0.22	−0.50	−4.1	−3.9
16	Leipzig	47 Geminor.	IB	−0.95	−0.79	+0.07	+0.52	+0.53	−0.25	−0.09	+0.51	+0.75	−4.6	−4.3
16	Washington	c Geminor.	IB	−0.70	−0.59	+0.21	+0.75	+0.77	−0.26	−0.10	+0.71	+0.40	+1.4	+1.6
21	Greenwich	β Virginis	IB	−0.96	+0.05	−0.03	−0.01	−0.03	−0.07	−0.48	−0.01	+0.95	−0.2	+0.1
21	Greenwich	β Virginis	E	+0.95	−0.05	−0.14	−0.03	−0.14	+0.15	+0.45	−0.01	−0.94	−0.6	−0.5
Dec. 7	Vienna	44 Piscium	I	−0.92	−0.40	−0.46	0.00	−0.46	−0.36	+0.36	−0.05	−0.79	+0.8	+1.1
9	Vienna	19 Arietis	I	−1.10	−0.80	−0.07	+0.04	−0.08	−0.19	+0.43	+0.03	−0.64	−0.8	−0.5
9	Strassburg	19 Arietis	I	−1.10	−0.79	+0.13	−0.08	−0.15	−0.29	+0.39	−0.11	−0.63	+0.4	+0.7
1876, Jan. 1	Washington	70 Aquarii	EB	+0.87	+0.04	−0.39	−0.18	+0.43	+0.26	−0.35	+0.16	+0.81	−7.8	−7.7
7	Strassburg	Anon. 19	I	−1.05	+0.92	+0.19	−0.27	−0.33	−0.31	+0.26	−0.29	−0.65	+0.3	+0.6
7	Strassburg	Anon. 25	I	−1.02	+0.88	−0.24	+0.34	+0.41	−0.12	+0.27	+0.35	−0.62	+5.2	+5.5
7	Strassburg	Anon. 22	I	−0.84	+0.74	+0.38	−0.54	−0.66	−0.34	+0.18	−0.55	−0.52	−0.1	+0.2
7	Strassburg	Anon. 13	I	−0.29	+0.25	+0.55	−0.79	−0.96	−0.31	+0.03	−0.82	−0.17	−0.7	−0.6
7	Strassburg	26 Tauri	I	−1.12	+0.96	−0.01	+0.01	+0.01	−0.24	+0.28	+0.02	−0.67	−1.8	−1.5
7	Strassburg	Anon. 30	I	−1.12	+0.97	0.00	0.00	0.00	−0.25	+0.28	−0.01	−0.68	+4.0	+4.3
7	Strassburg	27 Tauri	I	−0.93	+0.81	+0.32	−0.46	−0.56	−0.35	+0.21	−0.47	−0.57	0.0	+0.3
7	Strassburg	28 Tauri	I	−0.67	+0.58	+0.45	−0.66	−0.80	−0.34	+0.13	−0.66	−0.41	−0.9	−0.7
7	Strassburg	Anon. 40	I	−1.08	+0.94	−0.14	+0.21	+0.26	−0.17	+0.28	+0.22	−0.66	+2.0	+2.3
7	Strassburg	27 Tauri	EB	+1.04	−0.90	+0.20	−0.30	−0.37	+0.14	−0.27	+0.15	+0.63	+0.6	+0.7
10	Strassburg	47 Geminor.	I	−1.11	−0.83	+0.04	+0.23	+0.24	−0.29	−0.12	+0.24	−0.02	−0.8	−0.5
10	Washington	c Geminor.	I	−0.95	−0.71	−0.18	−0.53	−0.55	−0.11	−0.18	−0.52	−0.02	+2.1	+2.4
Feb. 2	Greenwich	27 Arietis	I	−0.94	−0.72	−0.35	+0.27	+0.44	+0.01	+0.39	+0.27	−0.90	+0.4	+0.7
2	Leipzig	27 Arietis	I	−0.82	−0.63	−0.48	+0.38	+0.62	+0.10	+0.36	+0.39	−0.79	−1.4	−1.1
2	Nr. Leipzig	27 Arietis	I	−0.82	−0.63	−0.48	+0.38	+0.62	+0.10	+0.36	+0.38	−0.79	−2.0	−1.7
2	Radcliffe	27 Arietis	I	−0.96	−0.74	−0.32	+0.24	+0.40	−0.01	+0.39	+0.25	−0.92	+0.1	+0.4
2	Radcliffe	27 Arietis	EB	+0.87	+0.66	−0.45	+0.33	+0.56	+0.35	−0.29	+0.37	+0.83	−5.0	−4.9
16	Washington	A Scorpii	E	+0.73	−0.72	−0.31	+0.50	−0.60	+0.17	+0.17	+0.52	−0.80	−2.1	−2.0
Mar. 4	Washington	49 Aurigæ	I	−0.52	−0.48	+0.09	+0.87	+0.87	−0.13	−0.02	+0.87	−0.45	−2.0	−1.8
4	Washington	49 Aurigæ	EB	+0.52	+0.48	+0.09	+0.87	+0.88	+0.05	+0.03	+0.87	+0.45	−1.9	−1.9
5	Cape	ι Geminor.	I	−0.95	−0.80	+0.14	+0.46	+0.48	−0.26	−0.13	−0.12	−0.72	−2.6	−2.3
5	Washington	c Geminor.	I	−0.65	−0.55	+0.29	+0.74	+0.80	−0.26	−0.10	+0.73	−0.49	−1.0	−0.8
5	Washington	c Geminor.	EB	+0.88	+0.74	+0.22	+0.55	+0.59	+0.07	+0.18	+0.54	+0.66	−1.1	−1.1
6	Nr. Leipzig	γ Cancri	I	−0.80	−0.57	+0.39	+0.55	+0.67	−0.34	−0.19	+0.57	−0.47	+2.7	+2.9
Apr. 1	Leipzig	47 Geminor.	I	−0.63	−0.57	+0.22	+0.78	+0.81	−0.24	−0.07	+0.78	−0.59	+0.4	+0.6
1	Vienna	47 Geminor.	I	−0.54	−0.49	+0.24	+0.84	+0.86	−0.21	−0.06	+0.84	−0.50	−1.2	−1.0
1	Radcliffe	47 Geminor.	I	−0.26	−0.22	+0.28	+0.93	+0.97	−0.16	−0.02	+0.94	−0.23	−1.0	−0.9
4	Strassburg	34 Leonis	I	−1.01	−0.58	−0.20	−0.11	−0.23	−0.06	−0.44	−0.12	−0.76	−0.2	+0.2
7	Greenwich	f Virginis	I	−0.93	+0.08	+0.34	−0.06	+0.35	−0.27	−0.40	−0.04	−0.22	−1.7	−1.3
7	Strassburg	f Virginis	I	−0.97	+0.09	+0.22	−0.04	+0.22	−0.21	−0.43	+0.66	−0.22	−0.3	+0.1
11	Greenwich	b Scorpii	E	+0.56	−0.52	+0.38	−0.70	+0.80	−0.16	+0.20	−0.68	−0.36	+0.3	+0.3

GROUP XII—1874-1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	a_0	∂_0	ι	P	n	n'
													″	″
1876, May 4	Washington	*f* Virginis	I	-0.88	+0.04	-0.43	+0.09	-0.44	+0.11	-0.48	+0.08	-0.58	-0.5	-0.1
5	Greenwich	50 Virginis	I	-0.90	+0.20	+0.34	-0.13	+0.37	-0.25	-0.38	-0.11	-0.48	-1.0	-0.6
June 1	Washington	50 Virginis	I	-0.92	+0.12	-0.26	+0.11	-0.27	+0.05	-0.47	+0.10	-0.83	-0.5	-0.1
5	Strassburg	65 B. Scorpii	I	-0.77	+0.65	-0.20	+0.49	-0.53	+0.09	-0.20	+0.49	-0.17	-0.7	-0.4
29	Leipzig	*i* Virginis	I	-0.94	+0.16	-0.20	+0.11	-0.23	+0.01	-0.46	-0.26	-0.96	-0.2	+0.2
29	Vienna	*i* Virginis	I	-0.93	+0.16	-0.21	+0.11	-0.24	+0.02	-0.46	-0.26	-0.96	-0.2	+0.2
29	Strassburg	*i* Virginis	I	-0.95	+0.16	-0.12	+0.07	-0.14	-0.02	-0.45	+0.06	-0.98	-0.9	-0.5
30	Vienna	43 H. Virginis	I	-0.93	+0.36	+0.08	-0.07	+0.10	-0.09	-0.37	-0.13	-0.93	-2.0	-1.6
July 13	Radcliffe	ε Piscium	IB	-0.87	-0.19	-0.44	+0.18	+0.47	+0.12	+0.47	+0.13	+0.88	-1.9	-1.5
16	Strassburg	Anon. 1	IB	-0.81	-0.58	+0.29	-0.61	-0.67	-0.33	+0.18	-0.56	+0.61	-3.3	-2.9
16	Strassburg	Anon. 1	E	+0.98	+0.69	+0.19	-0.41	-0.45	+0.09	+0.26	-0.39	-0.73	+0.7	+0.7
16	Strassburg	Anon. 7	E	+1.04	+0.74	+0.13	-0.29	-0.32	+0.13	-0.28	-0.28	-0.78	+2.6	+2.5
16	Strassburg	23 Tauri	IB	-1.08	-0.77	+0.05	-0.11	-0.12	-0.24	+0.27	-0.10	+0.81	-4.4	-3.9
16	Strassburg	23 Tauri	E	+1.08	+0.77	-0.06	+0.14	+0.15	+0.25	-0.25	+0.11	-0.81	+2.2	+2.1
16	Strassburg	Anon. 9	IB	-0.48	-0.34	+0.39	-0.81	-0.90	-0.31	+0.08	-0.74	+0.36	-1.7	-1.5
16	Strassburg	Anon. 8	IB	-0.43	-0.30	+0.40	-0.83	-0.92	-0.32	+0.07	-0.77	+0.32	-0.2	0.0
16	Strassburg	24 Tauri	IB	-1.02	-0.73	+0.15	-0.32	-0.36	-0.29	+0.24	-0.30	+0.76	-1.5	-1.0
16	Strassburg	η Tauri	IB	-1.04	-0.75	+0.12	-0.25	-0.28	-0.27	+0.25	-0.22	+0.79	-3.0	-2.5
16	Strassburg	Anon. 24	IB	-0.59	-0.43	+0.36	-0.76	-0.84	-0.33	+0.12	-0.65	+0.45	-7.8	-7.5
Oct. 5	Strassburg	ε Arietis	IB	-0.94	-0.49	+0.22	-0.36	-0.43	-0.28	+0.29	-0.32	+0.52	+1.4	+1.9
5	Strassburg	ε Arietis	E	+0.95	+0.50	+0.20	-0.34	-0.40	+0.02	-0.34	-0.30	-0.52	+0.4	+0.3
6	Strassburg	17 Tauri	IB	-0.97	-0.61	+0.14	-0.38	-0.41	-0.27	+0.23	-0.34	+0.64	+0.9	+1.4
6	Strassburg	17 Tauri	E	+1.05	+0.66	+0.05	-0.14	-0.15	+0.15	-0.28	-0.14	-0.69	+0.3	+0.2
6	Strassburg	23 Tauri	IB	-0.79	-0.50	-0.24	+0.62	+0.67	+0.03	+0.23	+0.58	+0.52	+4.1	+4.5
6	Strassburg	23 Tauri	E	+0.58	+0.37	-0.30	+0.78	+0.84	+0.30	-0.11	+0.70	-0.38	-0.2	-0.3
6	Strassburg	20 Tauri	IB	-0.43	-0.27	+0.33	-0.85	-0.92	-0.30	+0.08	-0.77	+0.20	+1.0	+1.2
6	Strassburg	20 Tauri	E	+0.70	+0.44	+0.27	-0.70	-0.75	-0.06	-0.21	-0.65	-0.46	+0.4	+0.3
6	Strassburg	24 Tauri	IB	-0.98	-0.62	-0.14	+0.37	+0.40	+0.08	+0.25	+0.35	+0.64	-0.9	-0.4
6	Strassburg	24 Tauri	E	+0.82	+0.52	-0.22	+0.60	+0.67	+0.30	-0.18	+0.52	-0.54	-0.3	-0.4
6	Strassburg	η Tauri	IB	-0.92	-0.59	-0.17	+0.36	+0.49	-0.04	+0.24	+0.42	+0.62	-0.2	+0.3
6	Strassburg	η Tauri	E	+0.75	+0.48	-0.25	+0.67	+0.71	+0.31	-0.17	+0.50	-0.50	-0.8	-0.9
6	Strassburg	Anon. 1	E	+1.01	+0.64	-0.11	+0.27	+0.29	+0.25	-0.26	+0.24	-0.6[illegible]	-3.5	-3.6
6	Strassburg	Anon. 15	E	+0.87	+0.55	-0.20	+0.54	+0.58	+0.30	-0.21	+0.48	-0.57	+0.2	+0.1
6	Strassburg	Anon. 18	E	+0.88	+0.56	-0.19	+0.52	+0.56	+0.28	-0.20	+0.46	-0.58	+0.1	0.0
6	Strassburg	Anon. 24	E	+1.05	+0.66	-0.05	+0.13	+0.13	+0.21	-0.25	+0.10	-0.69	-1.4	-1.5
6	Strassburg	Anon. 27	E	+1.02	+0.64	-0.10	+0.26	+0.28	+0.25	-0.25	+0.22	-0.67	-1.7	-1.8
6	Strassburg	Anon. 29	E	+1.02	+0.64	-0.10	+0.26	+0.28	+0.24	-0.24	+0.22	-0.67	-1.5	-1.6
6	Strassburg	Anon. 31	E	+0.99	+0.62	-0.12	+0.34	+0.37	+0.25	-0.23	+0.29	-0.65	-1.0	-1.1
6	Strassburg	Anon. 32	E	+0.95	+0.60	-0.15	+0.41	+0.44	+0.26	-0.22	+0.35	-0.63	-0.1	-0.2
6	Strassburg	Anon. 37	E	+0.74	+0.47	-0.24	+0.67	+0.71	+0.30	-0.16	+0.59	-0.49	0.0	-0.1
6	Strassburg	Anon. 39	E	+0.96	+0.61	-0.14	+0.40	+0.42	+0.26	-0.22	+0.34	-0.64	+0.7	+0.6
6	Nr. Leipzig	23 Tauri	IB	-0.76	-0.48	-0.25	+0.65	+0.70	+0.04	+0.22	+0.60	+0.50	-2.1	-1.7
6	Nr. Leipzig	24 Tauri	IB	-0.96	-0.61	-0.15	+0.39	+0.43	-0.07	+0.25	+0.39	+0.64	-2.3	-1.8
6	Nr. Leipzig	η Tauri	IB	-0.90	-0.58	-0.18	+0.48	+0.52	-0.03	+0.24	+0.44	+0.60	0.0	+0.4
6	Nr. Leipzig	20 Tauri	IB	-0.47	-0.29	+0.32	-0.84	-0.89	-0.30	+0.08	-0.75	+0.31	+1.7	+1.9
6	Nr. Leipzig	17 Tauri	IB	-0.98	-0.62	+0.14	-0.36	-0.38	-0.26	+0.23	-0.31	+0.64	-0.2	+0.3
6	Nr. Leipzig	16 Tauri	IB	-0.36	-0.22	+0.34	-0.88	-0.94	-0.30	+0.05	-0.79	+0.23	-0.7	-0.5
6	Nr. Leipzig	16 Tauri	E	+0.62	+0.40	+0.29	-0.74	-0.81	-0.10	-0.18	-0.67	-0.42	+1.6	+1.5
6	Leipzig	17 Tauri	IB	-0.98	-0.62	+0.14	-0.36	-0.38	-0.26	+0.23	-0.31	+0.64	+2.5	+3.0
6	Leipzig	16 Tauri	IB	-0.36	-0.22	+0.31	-0.88	-0.94	-0.30	+0.05	-0.79	+0.23	-0.8	-0.6
6	Leipzig	23 Tauri	IB	-0.75	-0.48	-0.25	+0.65	+0.70	+0.05	+0.22	+0.62	+0.50	-2.7	-2.3
6	Leipzig	20 Tauri	IB	-0.48	-0.29	+0.32	-0.84	-0.89	-0.31	+0.08	-0.74	+0.31	+0.8	+1.0
6	Leipzig	η Tauri	IB	-0.90	-0.58	-0.19	+0.48	+0.52	-0.03	+0.24	+0.45	+0.60	-0.7	-0.3
6	Leipzig	Anon. 24	IB	-1.04	-0.66	+0.05	-0.15	-0.14	-0.21	+0.25	-0.11	+0.69	-1.2	-0.7
6	Leipzig	Anon. 29	IB	-1.06	-0.67	0.00	0.00	0.00	-0.17	+0.26	+0.02	+0.70	-2.0	-1.4
6	Leipzig	Anon. 32	IB	-1.06	-0.66	-0.06	+0.15	+0.17	-0.16	+0.27	+0.15	+0.69	-0.9	-0.4
6	Leipzig	16 Tauri	E	+0.62	+0.40	+0.29	-0.74	-0.81	-0.10	-0.18	-0.69	-0.42	+2.2	+2.1
6	Leipzig	17 Tauri	E	+1.05	+0.66	+0.04	-0.10	-0.12	+0.15	-0.27	-0.11	-0.69	+2.3	+2.1
6	Leipzig	23 Tauri	E	+0.55	+0.35	-0.30	+0.80	+0.86	+0.30	-0.10	+0.85	-0.36	-1.9	-2.0
6	Leipzig	20 Tauri	E	+0.73	+0.47	+0.26	-0.67	-0.72	+0.26	+0.14	-0.82	-0.49	+0.[illegible]	+0.1
6	Leipzig	η Tauri	E	+0.72	+0.46	-0.25	+0.68	+0.73	+0.29	-0.15	+0.60	-0.48	-1.2	-1.3
6	Leipzig	Anon. 24	E	+1.04	+0.66	-0.05	+0.15	+0.15	+0.21	-0.25	+0.11	-0.69	-1.8	-2.0
6	Kiel	17 Tauri	IB	-0.94	-0.59	+0.17	-0.44	-0.47	-0.28	+0.23	-0.40	+0.63	-0.4	-0.1
6	Kiel	17 Tauri	E	+1.03	+0.65	+0.08	-0.22	-0.24	+0.03	-0.28	-0.21	-0.68	+1.5	+1.3
6	Kiel	16 Tauri	IB	-0.01	-0.01	+0.36	-0.93	-1.00	-0.25	-0.03	-0.86	+0.01	-0.1	-0.1
6	Kiel	16 Tauri	E	+0.28	+0.17	+0.35	-0.90	-0.96	-0.19	-0.11	-0.83	-0.18	+1.0	+1.0
6	Kiel	23 Tauri	IB	-0.86	-0.55	-0.21	+0.54	+0.58	0.00	+0.23	+0.50	+0.57	-2.7	-2.3
6	Kiel	20 Tauri	E	+0.51	+0.32	+0.31	-0.82	-0.88	-0.13	-0.16	-0.75	-0.34	+3.4	+3.3
6	Kiel	24 Tauri	IB	-1.01	-0.64	-0.11	+0.28	+0.30	-0.01	+0.27	+0.27	+0.67	-3.0	-2.5
6	Kiel	24 Tauri	E	+0.90	+0.57	-0.19	+0.50	+0.53	+0.28	-0.20	+0.43	-0.60	+1.1	+1.0

GROUP XII—1874–1890—Continued.

Date.		Place.	Star.		Ph.	λ	κ	iθ	ι	b_o	a_o	d_o	ε	P	n	n'
															"	"
1876, Oct.	6	Kiel		η Tauri	IB	−0.98	−0.62	−0.14	+0.37	+0.39	−0.08	+0.25	+0.35	+0.64	+0.8	+1.3
	6	Kiel		η Tauri	E	+0.84	+0.54	−0.21	+0.57	+0.61	+0.29	−0.20	+0.51	−0.56	+1.7	+1.6
	6	Berlin	17	Tauri	IB	−0.98	−0.62	+0.14	−0.36	−0.38	−0.26	+0.24	−0.31	+0.65	−1.7	−1.2
	6	Berlin	17	Tauri	E	+1.05	+0.66	+0.05	−0.12	−0.13	+0.15	−0.28	−0.13	−0.69	+1.4	+1.2
	6	Berlin	16	Tauri	IB	−0.35	−0.22	+0.34	−0.88	−0.95	−0.29	+0.05	−0.79	+0.23	−0.4	−0.2
	6	Berlin	16	Tauri	E	+0.61	+0.38	+0.29	−0.76	−0.82	−0.10	−0.19	−0.70	−0.40	+1.0	+0.9
	6	Berlin	23	Tauri	IB	−0.76	−0.48	−0.25	+0.65	+0.69	+0.04	+0.23	+0.59	+0.50	−1.5	−1.1
	6	Berlin	23	Tauri	E	+0.56	+0.36	−0.30	+0.79	+0.85	+0.30	−0.11	+0.71	−0.37	−1.2	−1.3
	6	Berlin	20	Tauri	IB	−0.47	−0.29	+0.32	−0.84	−0.90	−0.30	+0.08	−0.74	+0.31	−0.2	−0.5
	6	Berlin		η Tauri	IB	−0.91	−0.58	−0.18	+0.48	+0.51	−0.03	+0.26	+0.44	+0.60	−1.2	−0.7
	6	Berlin	24	Tauri	IB	−0.96	−0.61	−0.15	+0.39	+0.42	−0.06	+0.26	+0.37	+0.64	+2.0	+2.5
	6	Berlin		Anon. 24	IB	−1.05	−0.66	+0.05	−0.14	−0.15	−0.22	+0.27	−0.11	+0.69	+0.1	+0.6
	6	Berlin	20	Tauri	E	+0.72	+0.46	+0.26	−0.69	−0.73	−0.05	−0.20	−0.63	−0.48	+0.6	+0.5
	6	Berlin		η Tauri	E	+0.74	+0.47	−0.25	+0.67	+0.72	+0.30	−0.16	+0.60	−0.49	+0.6	+0.5
	27	Washington	64	Aquarii	I	−0.73	+0.49	+0.62	−0.12	−0.63	−0.33	+0.28	+0.28	−0.64	+1.9	+2.3
Nov.	23	Washington	42	Aquarii	I	−0.86	+0.72	+0.33	−0.10	−0.34	−0.17	+0.37	+0.18	−0.94	−1.7	−1.3
	24	Washington	81	Aquarii	I	−0.49	+0.32	+0.85	−0.05	−0.85	−0.42	+0.15	+0.27	−0.51	+1.1	+1.4
	29	Greenwich	47	Arietis	I	−0.97	+0.40	−0.22	+0.38	+0.44	−0.05	+0.33	+0.31	−0.28	+1.8	+2.3
	30	Nr. Leipzig	28	Tauri	I	−1.06	−0.60	+0.08	−0.25	−0.25	−0.28	+0.24	−0.21	−0.12	+0.2	+0.8
	30	Nr. Leipzig		η Tauri	I	−0.88	−0.50	+0.18	−0.58	−0.60	−0.32	+0.19	−0.50	−0.10	+0.9	+1.4
	30	Nr. Leipzig	26	Tauri	I	−0.81	−0.45	−0.20	+0.66	+0.68	−0.01	+0.21	+0.59	−0.09	−2.5	−2.0
	30	Nr. Leipzig	27	Tauri	I	−1.10	−0.62	−0.01	+0.03	+0.03	+0.26	+0.27	+0.04	−0.12	−0.3	+0.3
	30	Leipzig		η Tauri	I	−0.88	−0.50	+0.18	−0.57	−0.60	−0.32	+0.19	−0.50	−0.07	+0.4	+0.9
	30	Leipzig	27	Tauri	I	−1.10	−0.62	−0.01	+0.03	+0.03	−0.22	+0.27	+0.04	−0.12	−2.5	−1.9
	30	Leipzig	28	Tauri	I	−1.06	−0.60	+0.08	−0.25	−0.25	−0.28	+0.24	−0.21	−0.12	−0.8	−0.2
	30	Leipzig	27	Tauri	EB	+1.07	+0.60	−0.07	+0.22	+0.23	+0.27	−0.24	+0.18	+0.12	−1.0	−1.2
Dec.	26	Washington		μ Arietis	I	−1.01	−0.36	+0.14	−0.24	−0.27	−0.26	+0.32	−0.17	−0.69	−0.6	0.0
1877, Jan.	30	Greenwich	45	Leonis	E	+0.88	+0.69	+0.63	+0.12	+0.64	−0.07	+0.40	+0.26	−0.26	0.0	−0.2
	30	Greenwich		ρ Leonis	IB	−1.14	−0.89	−0.07	−0.01	−0.07	−0.24	−0.45	+0.02	+0.34	−1.3	−0.6
	30	Greenwich		ρ Leonis	E	+1.10	+0.86	−0.25	−0.03	−0.25	+0.36	+4.40	−0.16	−0.33	−0.2	−0.4
Feb.	26	Greenwich		α Leonis	I	−1.13	−0.93	+0.07	+0.02	+0.07	−0.29	−0.42	+0.08	−0.18	−0.6	+0.1
Mar.	23	Strassburg		κ Geminor.	I	−0.80	−0.72	+0.45	+0.49	+0.67	−0.29	−0.15	+0.68	−0.67	−1.7	−1.1
	26	Vienna		ρ Leonis	I	−0.93	−0.76	−0.55	−0.05	−0.55	+0.04	−0.43	−0.26	−0.44	−0.5	+0.2
	26	Strassburg		ρ Leonis	EB	+0.88	+0.71	−0.61	−0.05	−0.61	+0.47	+0.28	−0.29	+0.41	−3.7	−4.0
Apr.	22	Washington	45	Leonis	I	−1.05	−0.90	−0.23	−0.02	−0.23	−0.10	0.00	−0.13	−0.83	−1.0	−0.3
	26	Strassburg	85	Virginis	I	−0.59	−0.18	−0.52	−0.63	−0.82	+0.24	−0.30	+0.41	−0.11	−0.4	0.0
May	31	Strassburg	17	Capricor.	E	+0.82	−0.89	−0.37	−0.21	+0.42	+0.14	−0.28	−0.38	−0.76	−6.6	−6.9
July	6	Washington	16	Tauri	IB	−0.99	−0.23	+0.04	+0.31	+0.32	−0.08	+0.24	+0.28	−0.63	−2.0	−1.2
	6	Washington		q Tauri	IB	−1.02	−0.24	+0.02	−0.19	−0.19	−0.19	+0.23	−0.14	−0.65	−3.0	−2.2
	6	Washington		Anon. 4	I	−0.94	−0.22	−0.05	+0.42	+0.42	−0.05	+0.23	+0.41	−0.60	−3.3	−2.5
	6	Washington	20	Tauri	IB	−0.97	−0.22	−0.05	+0.38	+0.37	−0.07	+0.23	+0.35	−0.61	−1.0	−0.2
	6	Washington	21	Tauri	IB	−1.00	−0.23	+0.03	−0.28	−0.27	−0.21	+0.22	−0.21	−0.63	−3.7	−2.9
	6	Washington	22	Tauri	IB	−1.03	−0.24	+0.02	−0.13	−0.13	−0.12	+0.23	−0.10	−0.65	−4.1	−3.3
	6	Washington		Anon. 4	E	+0.77	+0.18	−0.08	+0.67	+0.68	+0.27	−0.16	+0.53	+0.48	+0.6	+0.3
	6	Washington		q Tauri	E	+1.04	+0.24	−0.01	+0.12	+0.12	+0.19	−0.24	+0.08	+0.65	−3.1	−3.5
	6	Washington	20	Tauri	E	+0.80	+0.18	−0.07	+0.63	+0.64	+0.26	−0.17	+0.53	+0.51	+1.9	+1.6
	6	Washington	22	Tauri	E	+1.02	+0.24	−0.02	+0.21	+0.20	+0.20	−0.23	+0.16	+0.65	+1.9	+1.5
Aug.	29	Strassburg		μ* Arietis	E	+0.86	−0.11	−0.14	−0.42	+0.44	+0.20	−0.28	+0.27	−0.85	+0.6	+0.2
	30	Strassburg	21	Tauri	E	+0.59	+0.09	−0.05	−0.81	+0.80	+0.24	−0.11	+0.67	−0.59	−0.4	−0.7
Sept.	18	Vienna	30	Capricor.	I	−0.78	+0.84	+0.48	+0.13	−0.50	−0.18	+0.29	+0.46	−0.61	0.0	+0.7
	25	Washington		μ Arietis	IB	−0.81	+0.18	−0.17	+0.51	+0.54	+0.10	+0.32	+0.39	+0.56	−3.4	−2.7
Nov.	20	Göttingen	17	Tauri	E	+0.40	−0.02	+0.01	+0.92	+0.92	+0.25	−0.06	+0.75	−0.02	+0.5	+0.3
	20	Göttingen		q Tauri	IB	−0.91	+0.05	0.00	−0.43	−0.43	−0.20	+0.21	−0.34	+0.05	−2.2	−1.4
	20	Göttingen	20	Tauri	IB	−1.00	+0.05	0.00	+0.11	+0.11	−0.10	+0.24	+0.14	+0.05	−1.9	−1.0
	20	Göttingen	20	Tauri	E	+0.93	−0.05	+0.01	+0.38	+0.38	+0.19	−0.20	+0.29	−0.05	−0.7	−1.2
	20	Greenwich		q Tauri	E	+0.94	−0.05	+0.01	−0.36	−0.36	+0.04	−0.01	−0.33	−0.05	−5.3	−5.8
	20	Greenwich	20	Tauri	E	+0.99	−0.05	0.00	+0.19	+0.19	+0.16	−0.22	+0.13	−0.05	−0.6	−1.2
	20	Greenwich	17	Tauri	E	+0.68	−0.03	+0.01	+0.74	+0.74	+0.25	−0.13	+0.60	−0.03	−3.8	−4.2
	20	Strassburg		q Tauri	E	+1.00	−0.05	0.00	+0.07	−0.08	+0.10	−0.23	−0.10	−0.05	−2.8	−3.4
	20	Strassburg	20	Tauri	E	+0.89	−0.04	0.00	−0.45	+0.45	+0.18	−0.19	+0.34	−0.04	−2.0	−2.5
	22	Göttingen	136	Tauri	IB	−0.27	−0.10	−0.48	−0.86	−0.97	−0.02	−0.01	−0.95	+0.12	−5.6	−5.3
1878, Jan.	10	Vienna	51	Piscium	I	−0.80	+0.77	−0.32	+0.32	+0.45	+0.18	+0.45	−0.05	−0.89	−0.2	+0.6
Feb.	15	Strassburg		η Cancri	I	−0.58	−0.42	−0.81	−0.28	−0.86	+0.14	−0.21	−0.69	−0.17	−1.5	−0.9
	15	Strassburg		η Cancri	E	+0.67	+0.47	−0.76	−0.27	−0.80	+0.38	+0.14	−0.72	+0.20	−1.6	−2.0
Mar.	7	Vienna	101	Piscium	I	−0.91	+0.73	−0.03	+0.08	+0.08	+0.01	+0.42	+0.09	−0.71	−2.7	−1.8
	16	Strassburg		A Leonis	I	−0.60	−0.50	+0.84	+0.12	+0.85	−0.49	−0.13	+0.49	−0.20	+1.2	+1.8
	16	Vienna		A Leonis	I	−0.85	−0.69	+0.67	−0.13	+0.68	−0.50	−0.23	+0.41	−0.28	+2.9	+3.8
	16	Greenwich		A Leonis	I	−0.49	−0.41	+0.89	−0.12	+0.90	−0.49	−0.10	+0.51	−0.17	−0.9	−0.4
Apr.	9	Vienna	37	Geminor.	I	−1.00	−0.45	+0.12	+0.12	+0.15	−0.14	−0.15	+0.74	−0.99	−1.9	−0.8
	13	Strassburg	48	Leonis	I	−1.11	−0.98	+0.05	+0.02	+0.05	−0.24	−0.43	+0.09	−0.67	+0.2	+1.4

GROUP XII—1874–1890—Continued.

Date.		Place.	Star.		Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
															″	″
1878, May	26	Strassburg	51	Piscium	E	+1.12	−0.96	+0.10	+0.12	−0.16	+0.17	−0.45	−0.05	−0.81	+3.7	+2.9
June	5	Greenwich	π	Canceri	I	−0.96	−0.72	+0.42	+0.01	+0.42	−0.30	−0.31	+0.36	−0.82	−0.5	+0.6
	14	Washington	3	Sagittarii	I	−0.65	−0.09	+0.49	+0.61	−0.78	−0.10	+0.01	+0.81	−0.04	−1.2	−0.5
	14	Washington	3	Sagittarii	EB	+0.40	+0.05	+0.58	+0.72	−0.92	+0.04	−0.01	+0.90	+0.02	+1.4	+1.1
	27	Strassburg	χ	Tauri	E	+0.98	−0.31	−0.02	+0.04	−0.04	+0.09	−0.15	−0.09	−0.41	+7.2	+6.5
Aug.	6	Vienna	4	Scorpii	I	−0.56	−0.35	+0.25	+0.79	−0.84	+0.08	−0.11	+0.75	−0.55	+0.3	+1.0
Sept.	5	Washington	σ	Sagittarii	I	−0.83	−0.02	+0.44	+0.26	−0.51	−0.14	+0.13	+0.56	−0.80	+0.2	+1.2
	6	Greenwich	51	Sagittarii	I	−0.88	+0.08	−0.37	−0.15	+0.40	+0.01	+0.22	−0.31	−0.82	+0.6	+1.7
	6	Vienna	51	Sagittarii	I	−0.69	+0.06	−0.64	−0.25	+0.69	+0.10	+0.20	−0.61	−0.64	−1.2	−0.4
	6	Strassburg	51	Sagittarii	I	−0.82	+0.08	−0.49	−0.19	+0.52	+0.04	+0.21	−0.44	−0.76	−1.7	−0.7
	17	Washington	χ	Tauri	E	+0.92	−0.39	+0.07	+0.16	+0.18	+0.07	−0.14	+0.09	−0.94	+3.6	+2.9
Oct.	5	Strassburg	θ	Capricor.	I	−0.90	+0.41	+0.24	−0.01	−0.24	−0.11	+0.33	+0.24	−0.89	−2.3	−1.2
Nov.	10	Strassburg	17	Tauri	IB	−0.91	+0.67	+0.05	+0.12	+0.14	0.00	+0.19	+0.18	+0.22	−4.7	−3.6
	10	Strassburg	17	Tauri	E	+0.84	−0.62	+0.14	+0.39	+0.41	+0.10	−0.17	+0.29	−0.20	+1.4	+0.7
	10	Strassburg	16	Tauri	E	+0.89	−0.66	−0.09	−0.23	−0.26	−0.02	−0.19	−0.28	−0.21	−2.9	−3.7
	10	Strasburg	20	Tauri	IB	−0.80	+0.58	−0.17	−0.49	−0.50	−0.13	+0.15	−0.38	+0.19	+2.9	+3.9
	10	Strassburg	20	Tauri	E	+0.89	−0.65	−0.10	−0.26	−0.28	−0.02	−0.19	−0.30	−0.21	+2.0	+1.2
	10	Greenwich	17	Tauri	IB	−0.92	+0.67	−0.05	−0.13	−0.14	−0.06	+0.20	−0.06	+0.22	−2.7	−1.6
	10	Greenwich	17	Tauri	E	+0.92	−0.67	+0.05	+0.14	+0.15	+0.07	−0.20	+0.08	−0.22	+4.0	+3.2
	10	Greenwich	20	Tauri	IB	−0.60	+0.44	−0.26	−0.71	−0.76	−0.17	+0.12	−0.61	+0.14	−1.1	−0.3
	10	Greenwich	η	Tauri	IB	−0.65	+0.48	+0.24	+0.67	+0.71	+0.11	+0.16	+0.64	+0.15	−0.9	−0.1
	10	Washington	η	Tauri	E	+0.91	−0.63	−0.07	−0.20	−0.21	0.00	−0.20	−0.25	−0.26	+2.1	+1.3
	13	Washington	ε	Geminor.	IB	−0.96	+0.05	−0.11	−0.06	−0.13	−0.06	−0.14	−0.08	+0.77	−1.7	−0.5
	13	Washington	ε	Geminor.	E	+0.96	−0.05	+0.14	+0.08	+0.16	+0.06	+0.14	+0.09	−0.77	+2.1	+1.3
	13	Washington	ε	Geminor.	IB	−0.96	+0.05	−0.11	−0.07	−0.13	−0.06	−0.13	−0.06	+0.78	−1.7	−0.5
	13	Washington	ε	Geminor.	E	+0.96	−0.05	+0.14	+0.08	+0.16	+0.06	+0.14	+0.09	−0.78	+3.0	+2.1
Dec.	2	Washington	λ	Piscium	EB	+0.88	−0.91	−0.12	+0.13	+0.18	+0.16	−0.42	−0.08	+0.95	−1.2	−2.0
	7	Washington	q	Tauri	I	−0.94	+0.72	0.00	0.00	0.00	−0.06	+0.19	−0.04	−0.27	−3.2	−2.0
	7	Washington	20	Tauri	I	−0.84	+0.64	+0.17	+0.42	+0.45	+0.03	+0.17	+0.48	−0.24	−1.0	+0.1
1879, Jan.	6	Strassburg	139	Tauri	I	−0.47	+0.14	+0.70	+0.55	+0.88	−0.10	−0.03	+0.91	−0.11	+0.1	+0.7
Feb.	3	Washington	ε	Geminor.	I	−1.00	+0.14	−0.03	−0.01	−0.03	−0.11	−0.14	+0.04	−0.48	−4.8	−3.5
	26	Vienna	26	Arietis	I	−0.89	+0.97	+0.02	+0.11	+0.11	+0.03	+0.32	+0.02	−0.91	−1.7	−0.5
	28	Washington	χ	Tauri	I	−0.75	+0.53	+0.32	+0.49	+0.59	+0.04	+0.11	+0.60	−0.81	−3.3	−2.3
	28	Washington	χ	Tauri	EB	+0.81	−0.57	+0.26	+0.39	+0.47	+0.07	−0.11	+0.37	+0.88	−1.0	−1.7
Apr.	1	Vienna	θ	Canceri	I	−0.84	−0.18	−0.56	+0.04	−0.56	+0.08	−0.29	−0.38	−0.71	−3.1	−2.0
	4	Strassburg	p^5	Leonis	IB	−0.96	+0.04	+0.30	−0.45	+0.52	−0.43	−0.30	+0.23	+0.82	−2.7	−1.5
	25	Washington	125	Tauri	I	−0.89	+0.48	−0.19	−0.13	−0.23	−0.01	−0.03	−0.15	−0.84	−4.3	−3.1
	26	Washington	52	B. Geminor.	I	−0.85	+0.25	−0.40	−0.16	−0.43	+0.01	−0.13	−0.36	−0.85	−3.7	−2.6
	30	Greenwich	83	B. Leonis	I	−0.47	−0.24	+0.79	−0.41	+0.89	−0.42	−0.11	+0.52	−0.41	−0.2	+0.4
May	3	Greenwich	q	Virginis	I	−0.72	−0.59	−0.26	+0.72	−0.77	+0.18	−0.35	+0.18	−0.30	+0.6	+1.5
	28	Washington	34	Sextantis	I	−1.01	−0.64	−0.19	+0.16	−0.25	−0.03	−0.45	−0.01	−0.96	−3.3	−2.0
June	30	Washington	48	B. Scorpii	I	−1.08	−0.90	−0.15	+0.19	−0.25	−0.18	−0.15	+0.31	−0.59	−0.4	+1.0
July	28	Greenwich	α	Scorpii	I	−0.38	−0.33	+0.65	+0.68	−0.94	+0.03	−0.05	+0.89	−0.30	+0.8	+1.3
	28	Greenwich	α	Scorpii	EB	+0.49	+0.41	+0.62	+0.64	−0.89	+0.16	+0.04	+0.79	+0.39	+1.3	+0.8
	28	Strassburg	α	Scorpii	I	−0.59	−0.50	+0.58	+0.60	−0.84	−0.02	−0.06	+0.83	−0.47	+0.3	+1.1
	28	Strassburg	α	Scorpii	EB	+0.73	+0.62	+0.52	+0.53	−0.74	+0.19	+0.07	+0.61	+0.59	−0.6	−1.3
Aug.	9	Strassburg	ε	Arietis	E	+0.85	−0.95	+0.12	+0.30	+0.32	+0.08	−0.23	+0.16	−0.95	+1.2	+0.4
	10	Strassburg		Anon. 17	E	+0.90	−0.61	−0.01	0.00	−0.01	+0.20	−0.13	−0.67	−0.98	+5.1	+4.2
	10	Strassburg		Anon. 19	E	+0.86	−0.96	−0.17	−0.24	−0.30	−0.03	−0.17	−0.08	−0.94	+1.2	+0.4
	10	Strassburg	27	Tauri	IB	−0.30	−0.92	−0.14	−0.78	−0.94	−0.15	−0.17	−0.33	+0.32	+0.6	+1.0
	10	Strassburg	27	Tauri	E	+0.52	−0.57	−0.46	−0.66	−0.87	−0.14	−0.11	−0.73	−0.58	+3.3	+3.8
	10	Strassburg	26	Tauri	E	+0.90	−0.96	−0.03	−0.04	−0.06	0.00	−0.17	−0.13	−0.98	+2.6	+1.7
	10	Strassburg		Anon. 34	E	+0.66	−0.70	+0.39	+0.56	+0.68	+0.11	−0.12	+0.48	−0.71	+3.5	+2.9
	10	Strassburg		Anon. 38	E	+0.87	−0.93	+0.15	+0.21	+0.26	+0.04	−0.16	+0.13	−0.95	+1.9	+1.1
	10	Strassburg		Anon. 40	E	+0.90	−0.96	+0.05	+0.07	+0.09	+0.02	−0.17	−0.01	−0.98	+2.8	+1.9
	25	Greenwich	142	B. Ophiuchi	I	−1.01	−0.83	+0.25	+0.18	−0.31	−0.15	−0.02	+0.38	−0.93	−0.4	+1.0
	28	Washington	ο	Capricor.	I	−0.51	−0.13	+0.85	−0.17	−0.87	−0.32	+0.48	+0.75	−0.29	+1.2	+1.9
Sept.	6	Washington	23	Tauri	IB	−0.82	+0.88	−0.24	−0.34	−0.42	−0.07	+0.15	−0.28	+0.87	−1.0	+0.1
	6	Washington	η	Tauri	IB	−0.71	+0.77	−0.36	−0.50	−0.61	−0.11	+0.12	−0.45	+0.76	−0.6	+0.4
	6	Washington	23	Tauri	E	+0.90	−0.97	−0.03	−0.04	−0.06	0.00	−0.17	−0.12	−0.96	+2.2	+1.3
	6	Washington	27	Tauri	IB	−0.90	+0.97	+0.04	+0.06	+0.07	0.00	+0.18	+0.15	+0.96	−2.1	−0.8
	6	Washington	28	Tauri	IB	−0.87	+0.94	−0.15	−0.19	−0.25	−0.04	−0.18	−0.11	+0.93	−1.7	−0.5
	6	Washington	24	Tauri	E	+0.82	−0.88	−0.24	−0.33	−0.41	−0.06	−0.17	−0.43	−0.87	+2.4	+1.6
	6	Washington	η	Tauri	E	+0.85	−0.92	−0.19	−0.27	−0.33	−0.05	−0.17	−0.37	−0.90	+2.0	+1.2
	6	Washington	26	Tauri	E	+0.32	−0.35	+0.56	+0.74	+0.93	+0.15	−0.05	+0.74	−0.34	−2.8	−3.1
	6	Washington	27	Tauri	E	+0.86	−0.93	+0.16	+0.22	+0.27	+0.04	−0.16	+0.16	−0.92	+0.9	+0.1
	6	Washington	28	Tauri	E	+0.90	−0.97	−0.02	−0.03	−0.04	0.00	−0.18	−0.11	−0.96	+1.8	+0.9
	26	Greenwich	λ	Capricor.	I	−0.98	+0.02	+0.06	−0.04	−0.07	−0.11	+0.39	+0.11	−0.72	+0.6	+2.0
Oct.	4	Greenwich	36	Tauri	E	+0.90	−0.97	−0.07	−0.08	−0.10	0.00	−0.14	−0.15	−0.78	+3.1	+2.2
	4	Strassburg	36	Tauri	E	+0.88	−0.96	+0.11	+0.12	+0.17	+0.02	−0.15	+0.07	−0.77	+3.7	+2.8

GROUP XII—1874-1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1879, Oct. 24	Strassburg	θ Aquarii*	I	−0.94	+0.02	+0.15	−0.13	−0.20	−0.14	+0.40	+0.15	−0.90	+0.6	+1.9
24	Strassburg	θ Aquarii	EB	+0.95	−0.02	−0.11	+0.10	+0.15	+0.12	−0.41	−0.14	+0.91	−3.5	−4.4
24	Berlin	θ Aquarii	I	−0.95	+0.02	+0.11	−0.12	−0.15	−0.12	+0.38	−0.35	−0.90	+0.1	+1.4
30	Strassburg	ε Arietis	E	+0.74	−0.83	−0.27	−0.48	−0.56	−0.14	−0.22	−0.45	−0.12	−8.2	−8.9
31	Cape	20 Tauri	E	+0.03	−0.93	+0.23	+0.29	+0.37	+0.06	−0.15	+0.31	−0.28	+0.3	−0.5
Nov. 16	Washington	λ Sagittarii	I	−0.35	−0.25	−0.92	−0.22	+0.95	+0.04	+0.05	−0.92	−0.20	−3.0	−2.5
16	Washington	λ Sagittarii	EB	+0.01	+0.01	−0.97	−0.23	+1.00	+0.12	+0.01	−0.99	+0.01	−0.5	−0.5
18	Greenwich	σ Capricor.	I	−1.04	−0.51	−0.16	+0.04	+0.17	−0.14	+0.30	−0.07	−0.83	−1.0	+0.4
22	Greenwich	16 Piscium	I	−0.77	+0.34	+0.23	−0.52	−0.57	−0.27	+0.30	+0.13	−0.78	+0.5	+1.6
Dec. 1	Washington	δ Geminor.	IB	−0.82	+0.50	−0.45	−0.01	−0.45	+0.07	−0.19	−0.36	+0.61	−2.0	−0.9
1	Washington	δ Geminor.	E	+0.82	−0.50	−0.45	0.00	−0.45	+0.11	+0.18	−0.51	−0.61	+0.4	−0.4
22	Greenwich	101 Piscium	I	−0.61	+0.52	+0.12	+0.73	+0.74	+0.25	+0.29	+0.28	−0.63	−0.3	+0.6
27	Nr. Leipzig	132 Tauri	I	−0.85	+0.84	+0.32	+0.12	+0.34	+0.01	−0.05	+0.42	−0.15	−3.0	−1.8
1880, Jan. 16	Strassburg	19 Piscium	I	−0.96	+0.31	+0.05	−0.15	−0.16	−0.13	+0.40	+0.09	−0.81	−1.1	−0.2
20	Greenwich	ε Arietis	I	−0.82	+0.87	−0.21	−0.34	−0.40	−0.06	+0.17	−0.18	−0.88	+1.2	+2.3
28	Strassburg	π Leonis	IB	−0.94	+0.04	−0.24	+0.22	−0.33	+0.05	−0.40	−0.09	+0.40	−5.3	−4.0
28	Strassburg	π Leonis	E	+0.80	−0.03	−0.43	+0.40	−0.59	+0.30	+0.27	−0.39	−0.34	−0.4	−1.2
28	Nr. Leipzig	π Leonis	I	−0.81	+0.03	−0.42	+0.38	−0.57	+0.16	−0.37	−0.29	+0.35	−5.5	−4.4
28	Nr. Leipzig	π Leonis	E	+0.62	−0.02	−0.57	+0.54	−0.78	+0.36	+0.18	−0.29	−0.26	+0.2	−0.4
Feb. 5	Cape	θ Ophiuchi	IB	−1.09	−0.97	+0.02	+0.01	−0.02	−0.19	0.00	+0.03	+0.83	−0.2	+1.3
5	Cape	θ Ophiuchi	E	+1.03	+0.92	+0.30	+0.14	−0.33	+0.18	−0.01	+0.34	−0.79	+1.3	+0.3
12	Strassburg	9 Piscium	I	−0.98	+0.19	−0.08	+0.20	+0.21	−0.01	+0.44	+0.04	−0.38	−2.8	−1.4
18	Cape	χ Tauri	I	−0.89	+0.99	−0.12	−0.09	−0.14	−0.02	+0.11	−0.08	−0.98	−2.5	−1.3
18	Nr. Leipzig	62 Tauri	I	−0.75	+0.84	+0.44	+0.33	+0.55	+0.06	+0.10	+0.57	−0.83	−3.9	−2.8
Mar. 3	Cape	26 Ophiuchi	E	+0.69	+0.63	−0.67	−0.36	+0.77	+0.09	+0.03	−0.79	−0.64	+0.7	0.0
4	Cape	7 Sagittarii	E	+1.04	+0.92	+0.19	+0.05	−0.20	+0.14	−0.08	+0.11	−0.95	+1.9	+0.9
4	Cape	9 Sagittarii	E	+1.07	+0.94	−0.03	−0.01	+0.03	+0.17	−0.08	−0.12	−0.97	−0.7	−1.8
13	Greenwich	101 Piscium	I	−0.78	+0.63	+0.10	+0.41	+0.42	+0.18	+0.33	+0.26	−0.45	−2.0	−0.9
13	Nr. Leipzig	101 Piscium	I	−0.88	+0.66	+0.08	+0.32	+0.34	+0.09	+0.36	+0.22	−0.47	−0.4	+0.8
18	Strassburg	132 Tauri	I	−0.83	+0.88	−0.36	−0.10	−0.38	+0.03	−0.04	−0.29	−0.93	−2.7	−1.5
18	Nr. Leipzig	132 Tauri	I	−0.92	+0.77	−0.56	−0.26	−0.59	−0.15	−0.04	−0.52	−0.81	−1.0	+0.3
21	Strassburg	d^2 Cancri	I	−0.85	+0.47	−0.43	+0.16	−0.46	+0.09	−0.29	−0.22	−0.68	−2.9	−1.7
21	Greenwich	d^2 Cancri	I	−0.82	+0.45	−0.47	+0.18	−0.50	+0.11	−0.29	−0.34	−0.67	−1.0	+0.1
25	Nr. Leipzig	13 B. Virginis	I	−0.94	−0.34	+0.11	−0.46	+0.47	−0.34	−0.32	+0.02	−0.02	−1.7	−0.4
30	Cape	B. A. C. 5641	E	+1.04	+0.95	−0.28	−0.15	+0.31	+0.18	+0.05	−0.39	−0.85	−0.9	−1.9
Apr. 1	Cape	ν^2 Sagittarii	E	+1.06	+0.90	+0.02	0.00	−0.02	+0.16	−0.17	−0.07	−1.00	+1.2	+0.1
2	Cape	*f* Sagittarii	E	+1.05	+0.79	+0.02	0.00	−0.02	+0.14	−0.25	+0.01	−0.98	−0.1	−1.1
11	Strassburg	47 Arietis	I	−0.87	+0.86	−0.18	−0.25	−0.31	−0.07	+0.22	−0.15	−0.39	−1.0	+0.2
16	Greenwich	56 Geminor.	I	−0.56	+0.46	+0.78	−0.10	+0.79	−0.15	−0.12	−0.65	−0.62	−2.4	−1.6
20	Washington	36 Sextantis	I	−0.91	−0.08	+0.22	−0.38	+0.44	−0.28	−0.34	+0.23	−0.60	−2.3	−1.0
20	Washington	36 Sextantis	EB	+1.02	+0.09	+0.02	−0.03	+0.03	+0.10	+0.43	−0.06	+0.67	−1.8	−2.8
26	Cape	19 Scorpii	E	+1.08	+0.94	−0.26	−0.18	+0.32	+0.20	+0.11	−0.37	−0.48	−0.6	−1.7
May 18	Greenwich	p^2 Leonis	I	−1.00	−0.16	+0.03	+0.06	+0.07	−0.12	−0.41	+0.09	−0.90	−2.5	−1.1
26	Cape	*o* Sagittarii	IB	−1.12	−0.91	−0.06	0.00	+0.06	−0.21	+0.19	−0.07	+0.59	−1.8	−0.2
June 12	Cape	83 B. Leonis	I	−0.43	+0.12	−0.58	+0.68	−0.89	+0.32	−0.25	−0.45	−0.42	−3.7	−3.1
13	Cape	89 B. Leonis	I	−0.91	+0.25	+0.18	−0.21	+0.28	−0.15	−0.35	+0.23	−0.90	−0.2	+1.1
13	Cape	89 B. Leonis	EB	+0.95	−0.26	−0.02	+0.03	−0.03	+0.06	+0.39	−0.38	+0.94	−5.6	−6.5
14	Cape	34 Sextantis	I	−0.96	+0.04	+0.04	−0.08	+0.09	−0.10	−0.40	+0.09	−1.00	−3.2	−1.8
18	Cape	43 H. Virginis	I	−1.04	−0.76	+0.15	+0.27	−0.31	−0.10	−0.30	+0.27	−0.67	−2.9	−1.4
20	Cape	19 Scorpii	I	−1.03	−0.88	−0.37	−0.23	+0.44	−0.27	−0.08	−0.32	−0.33	+0.7	+2.1
21	Cape	39 Ophiuchi	I	−1.11	−0.96	−0.26	−0.09	+0.28	−0.24	+0.01	−0.18	−0.19	−0.9	+0.6
25	Cape	c^1 Capricor.	IB	−1.04	−0.52	−0.16	+0.17	+0.23	−0.08	+0.39	−0.07	+0.67	−0.4	+1.1
25	Cape	c^1 Capricor.	E	+0.86	+0.43	−0.41	+0.44	+0.60	+0.37	−0.25	−0.43	−0.55	−0.1	−1.0
30	Cape	4 Arietis	E	+0.70	−0.41	−0.25	−0.61	−0.65	−0.19	−0.28	−0.39	−0.74	+0.1	−0.6
July 17	Nr. Leipzig	31 B. Scorpii	I	−1.09	−0.93	−0.09	−0.06	+0.11	−0.20	−0.15	−0.03	−0.78	−0.6	+0.9
19	Cape	4 Sagittarii	EB	+0.82	+0.71	+0.09	+0.09	−0.69	+0.12	−0.07	+0.61	+0.34	−5.5	−6.3
19	Cape	1 Sagittarii	I	−1.02	−0.89	−0.44	−0.03	+0.44	−0.18	+0.09	−0.36	−0.42	+1.4	+2.8
20	Cape	*o* Sagittarii	I	−1.14	−0.95	+0.01	0.00	−0.01	−0.24	+0.19	+0.02	−0.31	−0.1	+1.5
20	Cape	*o* Sagittarii	EB	+1.12	+0.93	+0.18	−0.02	−0.18	+0.20	−0.19	+0.20	+0.30	−1.2	−2.3
27	Cape	η Piscium	E	+0.92	−0.41	+0.08	+0.21	+0.23	+0.12	−0.31	+0.01	−0.92	−0.9	−1.8
30	Cape	36 Tauri	E	+0.47	−0.47	+0.71	+0.47	+0.85	+0.10	−0.06	+0.77	+0.49	+0.3	−0.2
Aug. 16	Cape	28 Sagittarii	I	−1.10	−0.96	+0.13	−0.01	−0.13	−0.23	−0.41	+0.10	−0.70	−0.4	+1.1
16	Cape	30 Sagittarii	I	−1.02	−0.90	+0.38	+0.04	+0.38	−0.13	+0.16	−0.29	−0.66	+1.2	+2.6
16	Cape	31 Sagittarii	I	−1.10	−0.97	+0.10	−0.01	−0.10	−0.21	+0.16	+0.19	−0.71	−0.1	+1.4
28	Nr. Leipzig	121 Tauri	IB	−0.81	+0.90	−0.42	−0.08	−0.42	+0.03	−0.03	−0.34	+0.85	−3.9	−2.8
Sept. 11	Berlin	θ Ophiuchi	I	−0.28	−0.26	+0.94	+0.21	−0.96	−0.04	0.00	+0.96	−0.26	+0.5	+0.9
12	Washington	117 B. Sagittarii	I	−0.85	−0.77	+0.61	−0.05	−0.61	−0.21	+0.11	+0.67	−0.75	+1.0	+2.2
13	Greenwich	50 Sagittarii	I	−0.79	−0.69	−0.65	+0.19	+0.68	+0.03	+0.17	−0.59	−0.67	−1.4	−0.3
14	Washington	47 B. Capricor.	I	−0.42	−0.31	+0.78	−0.49	−0.92	−0.34	+0.08	+0.79	−0.29	+1.1	+1.7
17	Washington	κ Piscium	I	−0.80	−0.14	−0.13	+0.62	+0.64	+0.16	+0.38	−0.02	−0.12	−2.6	−1.5

GROUP XII—1874-1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1880, Sept. 25	Nr. Leipzig	1 Geminor.	IB	−0.82	+0.91	+0.40	−0.02	+0.41	−0.04	−0.08	−0.34	+0.91	−3.7	−2.6
25	Nr. Leipzig	1 Geminor.	E	+0.88	−0.98	−0.21	−0.01	−0.21	0.00	−0.50	−0.29	−0.98	+4.4	+3.5
Oct. 7	Cape	δ Scorpii	I	−0.58	−0.46	+0.74	+0.42	−0.85	+0.01	−0.09	+0.71	−0.38	+0.1	+0.9
10	Cape	π Sagittarii	I	−0.81	−0.74	−0.64	+0.16	+0.66	−0.01	+0.17	−0.59	−0.76	−1.4	−0.3
10	Cape	π Sagittarii	EB	+0.52	+0.47	−0.84	+0.22	+0.87	+0.23	−0.07	−0.88	+0.48	−3.3	−3.8
15	Strassburg	16 Piscium	I	−0.97	−0.13	+0.04	−0.29	−0.29	−0.21	+0.37	+0.11	−0.46	+1.2	+2.6
Nov. 17	Greenwich	υ Tauri	IB	−0.95	+0.81	+0.28	+0.12	+0.31	−0.05	+0.09	+0.37	+0.12	−4.7	−3.3
19	Greenwich	η Geminor.	IB	−0.89	+0.99	−0.17	+0.01	−0.17	+0.03	−0.10	−0.10	+0.54	−3.0	−1.7
19	Greenwich	μ Geminor.	IB	−0.70	+0.78	−0.63	+0.05	−0.63	+0.07	−0.09	−0.57	+0.43	−1.7	−0.7
19	Greenwich	μ Geminor.	E	+0.65	−0.72	−0.69	+0.06	−0.69	+0.06	+0.08	−0.75	−0.40	+1.7	+1.0
20	Greenwich	ζ Geminor.	IB	−0.89	+0.98	+0.16	+0.04	+0.16	−0.02	−0.18	+0.24	+0.69	−7.6	−6.3
20	Greenwich	ζ Geminor.	E	+0.84	−0.92	+0.35	+0.09	+0.36	−0.07	+0.18	+0.27	−0.65	+2.6	+1.8
Dec. 12	Cape	26 Arietis	I	−0.88	+0.39	−0.23	−0.26	−0.35	−0.12	+0.23	−0.12	−0.70	−2.6	−1.4
1881, Jan. 5	Berlin	19 Piscium	I	−0.35	−0.13	+0.02	+0.94	+0.94	+0.33	+0.21	−0.04	−0.32	−3.7	−3.2
5	Greenwich	19 Piscium	I	−0.49	−0.17	+0.02	+0.88	+0.88	+0.28	+0.26	−0.02	−0.42	−1.4	−0.7
7	Washington	101 Piscium	I	−0.95	+0.16	−0.07	−0.12	−0.14	−0.09	+0.31	+0.03	−0.99	−1.6	−0.2
9	Strassburg	ζ Arietis	I	−0.62	+0.34	−0.60	−0.43	−0.74	−0.13	+0.12	−0.50	−0.62	−0.9	0.0
12	Greenwich	394 B. Tauri	I	−0.90	+0.93	−0.05	0.00	−0.05	+0.02	−0.05	+0.02	−0.52	−3.8	−2.5
Feb. 6	Washington	32 Tauri	I	−0.92	+0.67	+0.02	+0.01	+0.02	−0.01	+0.14	+0.10	−0.99	−3.4	−2.3
Mar. 8	Cape	1 Geminor.	I	−0.11	+0.11	+0.99	−0.12	+0.99	−0.07	−0.01	+0.98	−0.12	+0.4	+0.6
8	Greenwich	14 B. Geminor.	I	−0.90	+0.93	+0.04	−0.01	+0.04	+0.01	−0.09	+0.12	−0.98	−3.9	−2.6
16	Greenwich	q Virginis	IB	−0.90	+0.08	+0.38	+0.19	−0.42	+0.06	−0.20	+0.16	+0.20	−0.5	+0.8
16	Greenwich	q Virginis	E	+0.63	−0.06	+0.69	+0.35	−0.77	+0.33	+0.18	+0.12	−0.14	+1.0	+0.4
18	Cape	40 H. Virginis	E	+0.68	+0.22	+0.49	+0.55	−0.74	+0.27	+0.15	+0.42	−0.45	+1.8	+1.1
May 4	Greenwich	5 Cancri	I	−0.90	+1.00	−0.05	+0.04	−0.06	+0.04	−0.27	−0.28	−1.00	−5.9	−4.6
11	Berlin	75 Virginis	I	−0.55	−0.05	−0.49	−0.69	+0.84	−0.33	−0.12	−0.29	−0.17	−1.6	−0.8
21	Washington	16 Piscium	E	+0.81	+0.46	+0.02	+0.61	+0.61	+0.32	−0.26	−0.14	−0.73	+1.9	+1.1
July 5	Strassburg	83 Virginis	I	−0.89	−0.12	−0.30	−0.34	+0.46	−0.21	−0.26	−0.18	−0.80	+1.9	+3.1
18	Washington	27 Arietis	E	+0.72	−0.02	−0.54	−0.42	−0.68	−0.12	−0.21	−0.48	−0.72	−0.1	−0.8
Aug. 15	Washington	δ Arietis	IB	−0.93	+0.11	−0.28	−0.14	−0.32	−0.12	+0.19	−0.15	+0.93	−1.2	+0.1
15	Washington	δ Arietis	E	+0.98	−0.12	+0.01	0.00	+0.01	+0.06	−0.20	−0.09	−0.98	+3.0	+2.1
Sept. 3	Greenwich	33 Sagittarii	I	−0.90	−0.75	+0.51	−0.26	−0.57	−0.23	+0.12	+0.62	−0.70	+1.0	+2.3
Oct. 3	Cape	19 Aquarii	I	−0.82	−0.73	+0.27	−0.61	−0.67	−0.36	+0.20	+0.50	−0.58	+1.3	+2.4
5	Greenwich	κ Piscium	I	−1.09	−0.77	−0.03	−0.20	−0.20	−0.26	+0.36	+0.10	−0.42	+0.5	+2.0
5	Greenwich	9 Piscium	I	−1.03	−0.72	+0.06	+0.38	+0.30	−0.03	+0.38	+0.02	−0.40	+0.5	+1.9
9	Greenwich	54 Arietis	E	+0.46	0.00	+0.83	+0.36	+0.90	+0.23	−0.07	+0.63	−0.17	+0.2	−0.2
31	Cape	138 B. Aquarii	I	−1.08	−0.96	0.00	+0.02	+0.02	−0.15	+0.36	+0.08	−0.93	−1.1	+0.4
Nov. 1	Cape	3 Piscium	I	−0.64	−0.53	−0.06	−0.80	−0.80	−0.39	+0.15	+0.27	−0.52	−0.1	+0.9
12	Greenwich	α Cancri	IB	−0.89	+0.98	−0.08	+0.15	−0.17	+0.07	−0.31	−0.03	+0.97	−6.7	−5.5
12	Greenwich	α Cancri	E	+0.88	−0.97	−0.01	+0.18	−0.20	+0.04	+0.30	−0.25	−0.96	+1.7	+0.9
29	Greenwich	16 Piscium	I	−1.04	−0.82	+0.05	+0.19	+0.20	−0.06	+0.38	+0.04	−0.95	−2.0	−0.6
29	Greenwich	19 Piscium	I	−1.05	−0.84	0.00	0.00	0.00	−0.12	+0.36	+0.09	−0.97	−1.5	−0.1
Dec. 24	Cape	ξ Aquarii	I	−0.92	−0.83	+0.14	−0.54	−0.55	−0.34	+0.26	+0.43	−0.61	+1.7	+3.0
27	Cape	d Piscium	I	−1.04	−0.78	−0.03	−0.06	−0.07	−0.15	+0.35	+0.10	−1.00	−1.2	+0.2
30	Greenwich	45 Arietis	I	−0.97	−0.22	−0.17	−0.07	−0.18	−0.10	+0.21	−0.06	−0.86	−1.5	−0.1
1882, Feb. 7	Cape	χ Virginis	E	+0.88	−0.64	+0.15	+0.21	−0.26	+0.08	+0.31	+0.12	−0.82	+1.5	+0.7
11	Cape	ω^2 Scorpii	E	+0.99	+0.22	−0.15	−0.01	+0.15	+0.07	+0.11	−0.15	−0.93	+1.3	+0.4
12	Cape	116 B. Ophiuchi	E	+1.03	+0.44	+0.09	−0.02	−0.09	+0.11	+0.02	+0.01	−0.85	+3.0	+2.1
Mar. 8	Cape	621 B. Virginis	E	+0.93	−0.37	−0.12	−0.07	+0.14	−0.01	+0.28	−0.15	−0.77	+1.3	+0.5
Apr. 1	Greenwich	c Leonis	I	−0.03	+0.03	−0.35	−0.94	+1.00	−0.37	+0.06	+0.15	+0.01	−0.1	−0.1
20	Cape	247 B. Tauri	I	−0.81	−0.06	+0.61	−0.06	+0.61	−0.03	+0.06	+0.52	−0.42	−3.3	−2.3
May 6	Cape	16 Sagittarii	E	+1.01	+0.49	−0.15	+0.09	+0.18	+0.12	−0.09	−0.19	−0.77	+0.2	−0.0
29	Cape	621 B. Virginis	I	−0.96	+0.52	−0.05	−0.03	+0.06	−0.06	−0.26	+0.05	−0.51	−3.7	−2.4
June 4	Cape	g Sagittarii	E	+0.77	+0.46	+0.37	−0.60	−0.70	−0.05	−0.20	+0.55	−0.42	−1.5	−2.1
July 2	Cape	β Capricor.	IB	−0.12	+0.08	−0.44	−0.89	+0.99	+0.23	+0.06	−0.82	+0.04	+0.4	+0.6
21	Cape	χ Virginis	I	−0.87	+0.85	+0.18	−0.18	−0.26	+0.11	−0.34	+0.11	−0.93	−1.7	−0.6
Aug. 2	Greenwich	22 Piscium	E	+1.06	+0.94	−0.17	−0.27	−0.32	+0.06	−0.28	−0.04	−0.66	+0.9	0.0
18	Cape	50 Virginis	I	−0.85	+0.78	+0.28	−0.20	−0.35	+0.13	−0.32	+0.16	−0.77	−2.9	−1.9
27	Cape	19 Aquarii	I	−1.11	−0.88	−0.03	+0.21	+0.22	−0.14	+0.32	−0.07	−0.23	+0.4	+1.7
27	Cape	ξ Aquarii	I	−0.36	−0.28	+0.03	−0.95	−0.95	−0.37	+0.04	+0.60	−0.07	+0.3	+0.7
Sept. 7	Cape	5 Cancri	E	+0.67	−0.38	+0.31	−0.62	+0.69	−0.15	+0.18	+0.64	−0.59	+4.1	+3.6
20	Greenwich	μ Sagittarii	I	−0.91	−0.28	−0.32	+0.26	+0.41	−0.03	+0.08	−0.34	−0.89	−0.3	+0.7
20	Washington	21 Sagittarii	I	−1.01	−0.31	+0.09	−0.08	−0.12	−0.10	+0.11	+0.19	−0.97	−0.5	+0.6
Oct. 1	Greenwich	l Tauri	E	+0.69	+0.18	−0.67	+0.29	−0.73	+0.04	−0.01	−0.76	−0.57	−1.0	−1.5
22	Greenwich	κ Aquarii	I	−0.56	−0.48	+0.25	+0.83	+0.86	+0.21	+0.22	−0.31	−0.38	−1.8	−1.2
24	Greenwich	51 Piscium	I	−0.37	−0.32	+0.69	+0.64	+0.94	−0.25	+0.04	−0.11	−0.14	+3.2	+3.6
Nov. 2	Strassburg	κ Cancri	IB	−0.83	+0.57	−0.06	+0.42	−0.43	+0.14	−0.28	−0.37	+0.90	−2.9	−1.9
2	Strassburg	κ Cancri	E	+0.83	−0.57	−0.05	+0.44	−0.44	+0.11	+0.24	−0.34	−0.90	+2.4	+1.8
18	Cape	138 B. Aquarii	I	−0.72	−0.61	−0.15	−0.72	−0.74	−0.34	+0.17	+0.40	−0.66	+0.9	+1.7
18	Cape	B. D. −5° 5738	I	−0.10	−0.09	−0.19	−0.98	−1.00	−0.34	−0.04	+0.48	−0.10	+3.7	+3.8

GROUP XII—1874–1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	b_0	α_0	δ_0	ε	P	n	n′
													″	″
1882, Nov. 26	Hamburg	64 Orionis	IB	−0.98	−0.10	−0.24	+0.20	−0.31	−0.07	−0.07	−0.26	+0.28	−0.9	+0.2
26	Hamburg	64 Orionis	E	+1.00	+0.10	−0.20	+0.16	−0.25	+0.11	+0.07	−0.33	−0.29	−1.2	−1.9
Dec. 5	Cape	α Virginis	IB	−0.49	+0.51	−0.75	−0.39	+0.85	−0.24	−0.11	−0.29	+0.41	−0.6	−0.1
5	Cape	α Virginis	E	+0.67	−0.71	−0.60	−0.31	+0.68	−0.21	+0.25	−0.30	−0.57	+1.2	+0.7
1883, Jan. 4	Strassburg	κ Libræ	IB	−0.85	+0.49	+0.45	−0.06	−0.46	+0.05	−0.13	+0.38	+0.63	−1.9	−1.0
4	Hamburg	κ Libræ	I	−0.70	+0.40	+0.67	−0.09	−0.68	+0.09	−0.11	+0.57	+0.52	−0.6	+0.2
11	Hamburg	117 G. Capricor.	I	−0.87	−0.64	+0.07	+0.60	+0.60	+0.29	+0.28	−0.40	−0.47	−2.2	−1.2
11	Hamburg	c^1 Capricor.	I	−0.65	−0.47	+0.10	+0.80	+0.81	−0.06	+0.23	−0.44	−0.35	−0.7	0.0
12	Strassburg	κ Aquarii	I	−1.07	−0.89	+0.07	+0.19	+0.20	−0.08	+0.33	−0.08	−0.72	+0.3	+1.4
13	Hamburg	15 Piscium	I	−1.06	−0.95	−0.15	−0.20	−0.25	−0.24	+0.31	+0.09	−0.85	−0.2	+0.9
Feb. 14	Cape	164 B. Tauri	IB	−0.88	−0.08	+0.51	−0.14	+0.53	−0.16	−0.09	−0.40	+0.43	−1.9	−0.9
Mar. 12	Greenwich	ο Arietis	I	−1.00	−0.80	+0.43	+0.01	+0.43	−0.06	+0.21	+0.34	−0.67	−1.0	0.0
Apr. 17	Washington	36 Sextantis	I	−0.89	+0.76	+0.09	+0.19	−0.19	+0.10	−0.35	−0.03	−0.73	−1.7	−0.8
28	Cape	54 Sagittarii	E	+0.43	+0.11	−0.30	+0.85	+0.90	+0.18	−0.06	−0.87	−0.44	−1.6	−1.9
May 13	Cape	h Leonis	I	−0.84	+0.42	+0.08	+0.45	−0.46	+0.12	−0.29	−0.22	−0.88	−1.5	−0.7
17	Strassburg	χ Virginis	I	−0.90	+0.99	+0.05	+0.03	−0.06	+0.06	−0.33	−0.02	−0.72	−1.5	−0.6
June 14	Washington	62 Virginis	I	−0.31	+0.81	−0.89	−0.18	+0.94	+0.28	−0.21	−0.20	−0.72	−1.0	−0.7
July 15	Nikolaieff	β Scorpii	I	−0.82	+0.68	−0.42	−0.19	+0.46	−0.04	−0.11	−0.36	−0.65	+0.9	+1.7
17	Greenwich	16 G. Sagittarii	I	−0.87	+0.32	+0.29	−0.36	−0.46	−0.05	+0.04	+0.51	−0.33	−1.6	−0.7
19	Cape	e Sagittarii	I	−1.02	−0.04	+0.05	−0.17	−0.17	−0.16	+0.26	+0.19	+0.01	+0.3	+1.3
21	Washington	c^2 Capricor.	E	+1.04	+0.53	+0.06	+0.20	+0.20	+0.17	−0.27	−0.16	−0.47	−1.2	−1.8
Aug. 24	Greenwich	148 B. Tauri	E	+1.06	+0.90	−0.05	+0.02	−0.05	+0.11	−0.14	−0.08	−0.99	+1.7	+1.1
Sept. 6	Washington	α Libræ	I	−0.51	+0.55	+0.81	−0.12	−0.82	+0.20	−0.14	+0.59	−0.50	−0.1	+0.4
6	Washington	α Libræ	EB	+0.55	−0.62	+0.74	−0.12	−0.76	+0.09	+0.11	+0.48	+0.56	−1.5	−1.8
6	Washington	8 Libræ	I	−0.26	+0.28	+0.95	−0.15	−0.95	+0.21	−0.08	+0.67	−0.26	+2.6	+2.9
7	Cape	32 Libræ	I	−0.64	+0.64	+0.67	−0.22	−0.71	+0.14	−0.14	+0.51	−0.67	−2.2	−1.6
14	Greenwich	c^1 Capricor.	I	−0.24	−0.11	−0.32	−0.91	−0.98	−0.32	+0.03	+0.60	−0.09	−0.2	0.0
14	Greenwich	c^2 Capricor.	I	−1.08	−0.48	+0.02	+0.06	+0.06	−0.12	+0.30	+0.01	−0.41	−0.4	+0.6
16	Washington	21 Piscium	I	−0.62	−0.45	+0.66	+0.53	+0.84	+0.17	+0.23	−0.05	+0.03	−4.1	−3.5
Oct. 23	Prague	κ Cancri	IB	−0.91	−0.04	+0.07	+0.33	−0.34	+0.07	−0.25	−0.32	+0.93	−3.4	−2.6
23	Prague	κ Cancri	E	+0.90	+0.04	+0.08	+0.35	−0.36	+0.11	+0.23	−0.26	−0.92	−1.3	−1.8
Nov. 13	Cape	29 Arietis	I	−1.08	−0.93	−0.36	+0.04	−0.36	−0.29	+0.20	−0.18	−0.23	−0.6	+0.4
1884, Jan. 2	Cape	44 Aquarii	I	−1.01	−0.42	+0.04	+0.05	+0.06	−0.05	0.00	+0.01	−0.83	+1.1	+2.0
7	Cape	ο Arietis	I	−0.71	−0.66	+0.73	−0.17	+0.76	+0.06	+0.18	+0.53	−0.59	−2.4	−1.8
Feb. 6	Greenwich	120 Tauri	I	−1.07	−0.84	+0.04	−0.06	+0.07	−0.13	+0.01	+0.12	−0.82	−0.8	+0.2
6	Prague	119 Tauri	I	−1.07	−0.84	−0.04	+0.06	−0.07	−0.12	0.00	−0.03	−0.82	−1.4	−0.4
6	Prague	120 Tauri	I	−1.07	+0.83	+0.04	−0.06	+0.08	−0.13	0.00	−0.19	−0.82	−0.1	+0.9
6	Prague	119 Tauri	EB	+1.06	−0.84	−0.10	+0.14	−0.17	+0.12	0.00	+0.11	+0.81	+4.2	+3.7
16	Prague	λ Virginis	IB	−0.75	+0.81	+0.55	−0.08	−0.56	+0.18	−0.22	+0.35	+0.77	−2.7	−2.0
16	Prague	λ Virginis	E	+0.62	−0.66	+0.72	−0.11	−0.73	+0.15	+0.15	+0.38	−0.62	+1.4	+1.1
17	Prague	ν Libræ	E	+0.78	−0.87	−0.47	+0.18	+0.51	−0.14	+0.17	−0.43	−0.85	+2.3	+1.9
Mar. 3	Strassburg	δ Tauri	I	−1.03	−0.92	−0.23	+0.20	−0.30	−0.16	+0.10	−0.25	−0.94	−0.2	+0.7
3	Strassburg	64 Tauri	I	−1.07	−0.97	+0.06	−0.05	+0.08	−0.11	+0.11	+0.10	−0.99	−0.1	+0.8
6	Greenwich	λ Geminor.	I	−0.94	−0.56	−0.06	+0.42	−0.42	−0.02	−0.13	−0.36	−0.81	0.0	+0.9
6	Prague	λ Geminor.	I	−0.85	−0.51	−0.08	+0.57	−0.58	0.00	−0.12	−0.52	−0.73	−0.1	+0.6
8	Cape	209 B. Cancri	I	−0.78	−0.13	−0.22	−0.59	+0.63	−0.20	−0.17	+0.48	−0.48	−0.9	−0.2
9	Cape	89 B. Leonis	I	−0.91	+0.05	−0.21	−0.32	+0.38	−0.16	−0.25	+0.24	−0.40	−1.3	−0.5
9	Cape	π Leonis	I	−0.91	+0.05	−0.21	−0.32	+0.38	−0.16	−0.25	+0.23	−0.40	−1.7	−0.9
15	Cape	μ Libræ	E	+0.80	−0.88	−0.43	+0.14	+0.45	−0.13	+0.20	−0.30	−0.67	+0.2	−0.2
24	Cape	κ Aquarii	E	+0.98	+0.33	−0.27	−0.29	−0.40	−0.01	−0.31	+0.11	−0.31	+3.2	+2.8
Apr. 4	Washington	α Cancri	I	−0.24	−0.07	+0.30	+0.92	−0.97	+0.22	−0.09	−0.71	−0.22	+0.2	+0.4
6	Washington	34 Sextantis	I	−0.73	+0.12	−0.46	−0.47	+0.65	−0.21	−0.20	+0.27	−0.51	−1.5	−0.9
30	Berlin	B. D. +15° 1619	I	−1.06	−0.62	0.00	−0.17	+0.17	−0.15	−0.15	+0.20	−0.92	−0.2	+0.7
30	Berlin	B. D. +15° 1620	I	−0.47	−0.28	−0.02	+0.90	−0.90	+0.09	−0.08	−0.82	−0.41	+0.1	+0.5
30	Berlin	B. D. +15° 1624	I	−1.06	−0.62	0.00	+0.11	−0.11	−0.10	−0.16	−0.06	−0.92	0.0	+0.8
30	Berlin	B. D. +15° 1633	I	−1.05	−0.62	0.00	+0.21	−0.21	−0.09	−0.16	−0.16	−0.91	+0.9	+1.7
30	Berlin	B. D. +15° 1635	I	−0.95	−0.56	0.00	−0.45	+0.45	−0.18	−0.15	+0.46	−0.83	−0.7	+0.1
30	Berlin	B. D. +15° 1642	I	−0.94	−0.55	0.00	+0.48	−0.48	−0.03	−0.16	−0.40	−0.82	+0.3	+1.1
May 1	Cape	29 Cancri	I	−0.08	−0.04	−0.21	−0.98	+1.00	−0.21	+0.02	+0.82	−0.09	−0.2	−0.1
1	Washington	A^2 Cancri	I	−0.98	−0.43	−0.07	−0.23	+0.25	−0.13	−0.23	+0.24	−0.96	0.0	+0.8
2	Berlin	ω Leonis	I	−0.85	−0.21	−0.25	−0.50	+0.56	−0.22	−0.20	+0.42	+0.83	−0.3	+0.4
8	Berlin	λ Virginis	I	−0.69	+0.70	+0.62	−0.16	−0.64	+0.29	−0.21	+0.36	−0.19	−0.3	+0.3
8	Prague	λ Virginis	I	−0.74	+0.65	+0.56	−0.13	−0.58	+0.17	−0.35	+0.36	−0.18	+1.0	+1.6
29	Berlin	B. D. +10° 1956	I	−1.03	−0.38	+0.05	+0.12	−0.13	−0.06	−0.26	−0.05	−0.86	+0.9	+1.7
30	Cape	89 B. Leonis	I	−0.53	−0.08	−0.51	−0.68	+0.85	−0.28	−0.10	+0.48	−0.50	−0.5	−0.1
30	Greenwich	16 Sextantis	I	−1.00	−0.16	+0.01	+0.01	−0.01	−0.05	−0.30	+0.01	−0.95	0.0	+0.8
June 5	Cape	μ Libræ	I	−0.62	+0.63	−0.68	+0.23	+0.73	−0.14	−0.12	−0.50	−0.40	−0.5	0.0
28	Washington	υ Leonis	I	−0.88	+0.24	−0.37	−0.18	−0.41	−0.15	−0.26	+0.19	−0.85	−0.7	0.0
28	Washington	υ Leonis	EB	+0.94	−0.25	−0.20	−0.08	+0.22	−0.05	+0.32	+0.17	+0.92	−1.4	−1.8
28	Berlin	B. D. + 0° 2793	I	−0.92	+0.25	−0.27	−0.15	+0.31	−0.12	−0.29	+0.10	−0.88	+0.4	+1.1

GROUP XII—1874-1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	b_0	α_0	δ_0	ε	P	n	n′
													″	″
1884, July 3	Prague	32 Libræ	I	−0.38	+0.41	+0.76	−0.50	−0.91	+0.17	−0.09	+0.73	−0.33	+0.8	+1.1
11	Strassburg	θ Aquarii	IB	−0.94	−0.02	+0.20	+0.22	+0.30	+0.05	+0.31	−0.14	+0.70	+1.8	+2.5
15	Berlin	o Piscium	E	+1.00	+0.75	+0.41	−0.06	+0.41	+0.25	−0.23	+0.17	−0.91	−1.2	−1.6
30	Berlin	88 B. Libræ	I	−0.76	+0.66	−0.57	+0.35	+0.66	−0.18	−0.14	−0.47	−0.15	−3.0	−2.3
Aug. 15	Strassburg	115 Tauri	E	+1.09	+0.98	+0.01	−0.03	+0.03	+0.14	−0.03	+0.02	−0.90	+3.2	+2.8
Sept. 8	Berlin	B. D. + 9° 264	E	+1.07	+0.79	+0.19	−0.06	+0.20	+0.20	−0.25	+0.10	−0.72	+3.8	+3.4
12	Berlin	B. D. +17° 1101	E	+1.11	+0.96	−0.03	+0.09	−0.09	+0.16	+0.01	−0.11	−0.99	+1.2	+0.8
12	Berlin	B. D. +17° 1113	E	+0.99	+0.85	−0.13	+0.44	−0.46	+0.16	+0.02	−0.48	−0.88	−1.1	−1.5
12	Berlin	B. D. +17° 1136	E	+0.22	+0.19	+0.27	−0.94	+0.98	0.00	0.00	+0.97	−0.20	−0.6	−0.7
12	Berlin	B. D. +17° 1144	E	+1.00	+0.86	−0.11	+0.43	−0.44	+0.16	+0.03	−0.46	−0.89	−1.3	−1.7
12	Berlin	B. D. +17° 1145	E	+0.59	+0.51	−0.22	+0.82	−0.85	+0.11	+0.01	−0.87	−0.52	+2.0	+1.8
12	Berlin	B. D. +17° 1147	E	+1.11	+0.96	+0.01	−0.03	+0.03	+0.15	+0.04	0.00	−0.99	+1.2	+0.8
12	Berlin	B. D. +17° 1151	E	+1.10	+0.95	+0.03	−0.11	+0.11	+0.15	+0.03	+0.09	−0.98	+1.1	+0.7
12	Berlin	B. D. +17° 1158	E	+1.10	+0.95	−0.04	+0.14	−0.14	+0.16	+0.02	−0.16	−0.98	+1.2	+0.8
12	Berlin	B. D. +17° 1161	E	+0.11	+0.96	−0.03	+0.10	−0.10	+0.16	+0.02	−0.12	−0.99	+1.1	+0.7
12	Berlin	124 H^1. Orionis	E	+0.83	+0.72	−0.16	+0.64	−0.66	+0.14	+0.02	−0.68	−0.74	−0.3	−0.6
13	Berlin	B. D. +16° 1380	E	+1.03	+0.83	−0.07	+0.34	−0.35	+0.18	+0.08	−0.36	−0.88	0.0	−0.4
13	Berlin	B. D. +17° 1495	E	+0.66	+0.53	−0.17	+0.78	−0.80	+0.18	+0.07	−0.80	−0.56	−1.3	−1.6
13	Berlin	B. D. +16° 1385	E	+1.09	+0.88	−0.03	+0.15	−0.15	+0.17	+0.10	−0.18	−0.94	+0.8	+0.4
13	Berlin	B. D. +17° 1502	E	+0.57	+0.45	−0.18	+0.84	−0.86	+0.18	+0.05	−0.85	−0.48	+0.8	+0.6
13	Berlin	B. D. +16° 1395	E	+1.10	+0.88	−0.01	+0.05	−0.05	+0.16	+0.11	−0.08	−0.94	+0.9	+0.5
13	Berlin	B. D. +16° 1398	E	+0.99	+0.79	+0.09	−0.43	+0.44	+0.09	+0.11	+0.41	−0.85	+0.9	+0.5
13	Berlin	B. D. +16° 1400	E	+1.09	+0.86	+0.04	−0.20	+0.20	+0.14	+0.11	+0.17	+0.92	−0.3	−0.7
14	Berlin	B. D. +14° 1822	E	+0.59	+0.41	−0.17	−0.82	+0.84	−0.07	+0.11	+0.73	−0.47	+1.2	+1.0
14	Berlin	B. D. +14° 1825	E	+0.96	+0.66	−0.10	−0.45	+0.46	+0.03	+0.18	+0.38	−0.77	+0.8	+0.4
14	Berlin	B. D. +14° 1828	E	+1.04	+0.71	−0.06	−0.20	+0.27	+0.08	+0.18	+0.22	−0.83	−0.1	−0.5
14	Berlin	B. D. +14° 1829	E	+1.04	+0.71	−0.06	−0.26	+0.27	+0.07	+0.19	+0.21	−0.83	+0.7	+0.3
14	Berlin	B. D. +14° 1838	E	+0.94	+0.64	−0.11	−0.49	+0.50	+0.01	+0.18	+0.42	−0.75	+0.9	+0.5
14	Berlin	B. D. +14° 1839	E	+0.86	+0.59	+0.13	+0.58	−0.60	+0.21	+0.14	−0.55	−0.69	−1.0	−1.4
15	Berlin	B. D. +11° 1974	E	+0.54	+0.30	−0.38	−0.79	+0.87	−0.12	+0.15	+0.66	−0.38	+0.4	+0.2
26	Berlin	290 B. Ophiuchi	I	−0.77	+0.84	+0.16	−0.48	−0.50	+0.05	+0.06	+0.53	−0.87	−1.4	−0.8
28	Berlin	B. D. −17° 5672	I	−0.86	+0.70	+0.04	+0.35	+0.35	+0.08	+0.13	−0.32	−0.89	−0.8	+1.5
28	Berlin	B. D. −17° 5699	I	−0.92	+0.74	−0.01	−0.05	−0.05	+0.02	+0.15	+0.01	−0.95	−2.6	−1.9
Oct. 9	Prague	130 Tauri	E	+1.09	+0.99	+0.01	−0.04	+0.04	+0.14	0.00	+0.03	−0.89	+0.4	0.0
28	Cape	c^1 Capricor.	I	−0.58	+0.17	+0.52	+0.60	+0.80	+0.19	+0.20	−0.42	−0.55	−1.4	−1.0
28	Cape	c^1 Capricor.	EB	+0.30	−0.09	+0.63	+0.71	+0.95	+0.26	−0.03	−0.59	+0.29	−3.1	−3.2
30	Berlin	11 Piscium	I	−0.99	−0.19	−0.24	−0.10	−0.26	−0.15	+0.28	+0.05	−0.63	−1.0	−0.3
Nov. 22	Berlin	B. D. −17° 5748	I	−0.36	+0.29	+0.19	+0.90	+0.92	+0.13	+0.06	−0.85	−0.34	−0.3	−0.1
25	Prague	θ Aquarii	I	−0.94	+0.20	−0.18	−0.15	−0.23	−0.08	+0.27	+0.11	−0.97	−0.8	−0.1
29	Cape	54 Ceti	I	−0.46	−0.27	−0.89	+0.19	−0.91	−0.31	+0.07	−0.41	−0.26	−0.3	0.0
Dec. 1	Cape	148 B. Tauri	I	−1.15	−0.93	+0.04	−0.03	+0.05	−0.21	+0.16	+0.08	−0.18	−1.7	−0.9
30	Greenwich	115 Tauri	I	−1.11	−0.96	−0.09	+0.26	−0.28	−0.21	+0.04	−0.27	−0.32	−0.7	+0.1
1885, Jan. 4	Cape	48 Leonis	E	+1.01	+0.50	+0.24	+0.15	−0.28	+0.19	+0.27	−0.15	−0.60	−0.2	−0.5
20	Berlin	B. D. − 3° 5639	I	−1.00	−0.04	+0.11	+0.04	+0.12	−0.01	+0.32	−0.02	−0.82	−0.5	+0.2
20	Berlin	B. D. − 3° 5642	I	−1.00	−0.04	−0.15	−0.05	−0.16	−0.11	+0.31	+0.02	−0.82	−2.1	−1.4
20	Berlin	B. D. − 3° 5643	I	−0.99	−0.04	+0.17	−0.06	−0.18	−0.11	+0.31	+0.03	−0.81	−1.8	−1.1
20	Berlin	B. D. − 3° 5644	I	−0.73	−0.04	+0.66	+0.22	+0.70	+0.17	+0.26	−0.12	−0.60	+0.7	+1.2
21	Berlin	98 B. Piscium	I	−0.99	−0.04	−0.19	−0.02	−0.19	−0.11	+0.30	−0.01	−0.81	−2.8	−2.1
22	Berlin	ε Piscium	I	−1.03	−0.43	+0.19	−0.03	+0.19	−0.04	+0.30	+0.05	−0.97	+1.0	+1.7
22	Prague	ε Piscium	I	−0.95	−0.42	+0.32	−0.05	+0.33	+0.05	+0.27	−0.14	−0.94	−0.7	0.0
22	Strassburg	ε Piscium	I	−0.96	−0.42	+0.31	−0.05	+0.32	+0.04	+0.29	+0.08	−0.94	−0.1	+0.6
22	Strassburg	ε Piscium	EB	+0.88	+0.39	+0.47	−0.08	+0.48	+0.18	−0.34	+0.14	+0.87	+0.9	+0.6
23	Berlin	B. D. + 8° 307	I	−0.98	−0.61	+0.35	−0.16	+0.39	0.00	+0.26	+0.20	−0.92	−0.5	+0.2
23	Berlin	B. D. + 8° 314	I	−1.05	−0.65	+0.19	−0.08	+0.21	−0.07	+0.27	+0.11	−0.98	+2.3	+3.0
23	Berlin	B. D. + 9° 264	I	−0.59	−0.36	−0.76	+0.34	−0.84	−0.29	+0.12	−0.44	−0.55	−1.9	−1.5
23	Berlin	B. D. + 9° 266	I	−0.86	−0.53	−0.55	+0.25	−0.60	−0.27	+0.20	−0.32	−0.80	−0.4	+0.2
24	Berlin	B. D. +12° 411	I	−1.09	−0.81	−0.07	+0.05	−0.09	−0.15	+0.21	−0.04	−0.96	−3.1	−2.4
24	Berlin	B. D. +12° 410	I	−0.46	−0.34	−0.73	+0.55	−0.91	−0.26	+0.08	−0.64	−0.40	−1.1	−0.8
25	Berlin	B. D. +15° 546	I	−1.09	−0.81	−0.01	+0.01	−0.01	−0.13	+0.16	−0.01	−0.96	−2.4	−1.7
25	Berlin	B. D. +15° 547	I	−1.06	−0.79	+0.16	−0.20	+0.25	−0.09	+0.16	+0.23	−0.93	+0.8	+1.5
25	Berlin	B. D. +15° 557	I	−0.83	−0.62	+0.39	−0.52	+0.65	0.00	+0.13	+0.57	−0.73	−1.0	−0.4
26	Berlin	318 B. Tauri	I	−0.52	−0.46	+0.34	−0.81	+0.88	−0.01	+0.03	+0.87	−0.36	−2.2	−1.8
28	Strassburg	λ Geminor.	I	−1.12	−0.92	+0.03	+0.17	−0.17	−0.16	−0.10	−0.15	−0.44	−1.3	−0.5
Feb. 1	Berlin	d Leonis	E	+1.04	+0.36	+0.01	0.00	−0.01	+0.09	+0.29	+0.07	−0.38	+0.9	+0.6
20	Greenwich	38 Arietis	I	−0.32	−0.22	−0.77	+0.55	−0.95	−0.25	+0.05	−0.62	−0.29	−1.0	−0.8
21	Berlin	B. D. +14° 592	E	+0.20	+0.16	+0.63	−0.76	+0.99	+0.20	−0.01	+0.82	+0.18	−3.7	−3.8
21	Berlin	B. D. +14° 595	I	−1.05	−0.84	+0.19	−0.23	+0.30	−0.09	+0.18	+0.26	−0.95	+1.2	+1.9
21	Berlin	B. D. +14° 597	I	−1.07	−0.85	+0.16	−0.20	+0.26	−0.11	+0.18	+0.22	−0.97	+1.6	+2.3
21	Berlin	B. D. +14° 598	I	−0.73	−0.58	+0.48	−0.58	+0.76	+0.02	+0.14	+0.64	−0.66	−0.2	+0.3
21	Berlin	B. D. +14° 600	I	−1.10	−0.88	−0.02	+0.02	−0.03	−0.15	+0.17	−0.01	−1.00	−3.3	−2.6

GROUP XII—1874-1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
1885, Feb. 22	Berlin	α Tauri	I	−0.42	−0.36	+0.41	−0.82	+0.92	+0.05	+0.05	+0.86	−0.38	+0.6	+0.9
22	Berlin	α Tauri	EB	+0.38	+0.33	+0.42	−0.83	+0.94	+0.12	−0.04	+0.88	+0.34	+1.2	+1.1
23	Greenwich	130 Tauri	I	−1.05	−0.97	−0.05	+0.24	−0.25	−0.14	+0.02	−0.25	−0.89	−2.1	−1.4
23	Strassburg	130 Tauri	I	−1.06	−0.97	−0.04	+0.22	−0.22	−0.14	+0.01	−0.22	−0.89	−2.8	−2.1
24	Berlin	B. D. +17° 1339	I	−0.95	−0.84	+0.01	+0.52	−0.52	−0.11	−0.06	−0.50	−0.72	−1.2	−0.5
24	Berlin	B. D. +17° 1392	I	−1.11	−0.98	0.00	−0.05	+0.05	−0.07	−0.07	−0.07	−0.84	−2.4	−1.7
24	Berlin	B. D. +17° 1393	I	−0.78	−0.68	−0.04	−0.71	+0.71	−0.15	−0.05	+0.71	−0.59	−2.4	−1.9
Mar. 4	Cape	κ Virginis	E	+0.92	−0.45	+0.26	−0.14	−0.30	+0.10	+0.23	+0.20	−0.67	+2.2	+2.0
21	Berlin	B. D. +15° 630	I	−0.97	−0.81	+0.22	−0.42	+0.47	−0.08	+0.13	+0.44	−0.83	+0.1	+0.7
21	Berlin	75 Tauri	I	−1.06	−0.88	+0.12	−0.24	+0.27	−0.11	+0.13	+0.25	−0.90	+1.5	+2.1
21	Berlin	B. D. +15° 633	I	−0.28	−0.23	+0.43	−0.87	+0.97	+0.07	+0.03	+0.90	−0.24	+0.7	+0.9
21	Berlin	264 B. Tauri	I	−0.46	−0.39	+0.40	−0.82	+0.91	−0.05	+0.06	+0.86	−0.39	−1.0	−0.7
22	Berlin	B. D. +17° 918	I	−0.94	−0.83	−0.13	+0.51	−0.53	−0.16	+0.04	−0.52	−0.84	−0.3	+0.3
22	Berlin	B. D. +17° 919	I	−1.01	−0.89	+0.10	−0.40	+0.41	−0.12	+0.07	+0.39	−0.90	−0.5	+0.1
22	Berlin	111 Tauri	I	−1.01	−0.89	+0.10	−0.40	+0.41	−0.12	+0.07	+0.39	−0.90	−1.0	−0.4
22	Berlin	B. D. +17° 921	I	−0.88	−0.77	−0.15	+0.61	−0.62	−0.16	+0.04	−0.60	−0.78	+0.4	+0.9
22	Berlin	B. D. +17° 929	I	−0.75	−0.67	+0.16	−0.71	+0.73	−0.05	+0.03	+0.72	−0.67	−0.7	−0.2
22	Berlin	117 Tauri	I	−0.64	−0.57	+0.18	−0.79	+0.81	−0.05	+0.03	+0.81	−0.57	−0.9	−0.5
22	Berlin	B. D. +17° 943	I	−1.02	−0.90	+0.08	−0.39	+0.40	−0.13	+0.06	+0.40	−0.91	+0.4	+1.0
22	Berlin	B. D. +17° 945	I	−1.05	−0.89	+0.08	+0.40	−0.41	−0.16	+0.05	−0.40	−0.90	−1.1	−0.6
22	Berlin	B. D. +17° 950	I	−1.07	−0.94	−0.05	+0.26	−0.27	−0.15	+0.02	−0.26	−0.95	−1.0	−0.4
22	Prague	111 Tauri	I	−0.92	−0.85	+0.13	−0.49	+0.50	−0.08	+0.03	+0.50	−0.86	−0.5	+0.1
22	Greenwich	111 Tauri	I	−0.91	−0.83	+0.14	+0.51	+0.53	−0.07	+0.05	+0.51	−0.84	−1.4	−0.9
22	Greenwich	117 Tauri	I	−0.26	−0.24	+0.23	−0.94	+0.97	+0.01	+0.01	+0.96	−0.24	−0.8	−0.6
23	Berlin	B. D. +17° 1225	I	−1.05	−0.95	0.00	−0.32	+0.32	−0.16	−0.01	+0.33	−0.95	+0.4	+1.0
23	Berlin	B. D. +17° 1226	I	−0.83	−0.75	0.00	+0.66	−0.66	−0.09	−0.03	−0.65	−0.75	−1.3	−0.8
23	Berlin	B. D. +17° 1230	I	−0.88	−0.79	0.00	−0.61	+0.61	−0.14	−0.02	+0.62	−0.79	−0.9	−0.4
23	Berlin	B. D. +17° 1231	I	−0.87	−0.78	0.00	−0.62	+0.62	−0.13	−0.02	+0.63	−0.78	−2.7	−2.2
23	Berlin	B. D. +17° 1238	I	−0.99	−0.89	0.00	−0.46	+0.46	−0.16	−0.02	+0.47	−0.80	−1.7	−1.1
23	Berlin	B. D. +17° 1241	I	−0.69	−0.62	0.00	−0.78	+0.78	−0.12	−0.02	+0.78	−0.62	−0.8	−0.4
23	Berlin	B. D. +17° 1247	I	−1.08	−0.97	0.00	+0.23	−0.23	−0.14	−0.04	−0.22	−0.97	0.0	+0.6
23	Berlin	B. D. +17° 1252	I	−1.11	−1.00	0.00	−0.08	+0.08	−0.16	−0.02	+0.09	−1.00	−1.2	−0.6
23	Berlin	B. D. +17° 1256	I	−0.94	+0.34	−0.01	−0.34	+0.34	−0.06	−0.02	+0.35	−0.94	−0.6	0.0
23	Berlin	B. D. +17° 1261	I	−0.81	−0.73	+0.01	+0.67	−0.67	−0.08	−0.03	+0.67	−0.73	−1.4	−0.9
23	Berlin	B. D. +17° 1263	I	−0.61	−0.55	−0.02	−0.84	+0.84	−0.12	−0.01	+0.84	−0.55	−1.5	−1.1
23	Berlin	B. D. +17° 1277	I	−0.83	−0.75	+0.01	+0.66	−0.66	−0.09	+0.04	−0.65	−0.75	−1.3	−0.8
23	Berlin	B. D. +17° 1280	I	−1.03	−0.93	−0.01	−0.37	+0.37	−0.16	−0.03	+0.38	−0.93	+0.3	+0.9
23	Berlin	B. D. +17° 1281	I	−0.92	−0.83	−0.01	−0.55	+0.55	−0.15	−0.03	+0.56	−0.83	−1.4	−0.9
23	Berlin	B. D. +17° 1288	I	−0.87	−0.78	−0.02	−0.62	+0.62	−0.15	+0.04	+0.62	−0.78	−1.0	−0.5
23	Berlin	B. D. +17° 1291	I	−0.60	−0.54	−0.03	−0.84	+0.84	−0.12	−0.02	+0.84	−0.54	−1.4	−1.0
23	Berlin	B. D. +17° 1294	I	−0.98	−0.88	−0.02	−0.47	−0.47	−0.49	+0.38	+0.48	−0.88	−1.1	−0.5
23	Berlin	B. D. +17° 1307	I	−1.03	−0.93	+0.01	+0.37	−0.37	−0.14	−0.05	−0.37	−0.93	−0.2	+0.4
27	Greenwich	43 Leonis	I	−0.85	−0.45	+0.51	+0.31	−0.60	+0.08	−0.26	−0.25	−0.47	−1.3	−0.8
28	Greenwich	75 Leonis	I	−1.00	−0.35	−0.25	−0.08	+0.26	−0.16	−0.29	+0.08	−0.40	−1.1	−0.5
Apr. 2	Cape	γ Libræ	IB	−0.78	+0.60	+0.36	−0.42	−0.55	+0.10	−0.17	+0.39	+0.51	−1.5	−1.0
2	Cape	γ Libræ	E	+0.72	−0.55	+0.41	−0.49	−0.64	+0.11	+0.12	+0.57	−0.48	+0.8	+0.6
4	Cape	125 B. Ophiuchi	E	+0.41	−0.42	−0.29	+0.85	+0.89	−0.08	+0.04	−0.87	−0.39	−0.5	−0.6
18	Berlin	B. D. +17° 862	I	−0.86	−0.74	−0.18	+0.60	−0.62	−0.17	+0.05	−0.60	−0.59	+0.5	+1.0
19	Berlin	B. D. +17° 1136	I	−0.80	+0.24	+0.03	−0.57	+0.57	−0.02	−0.01	+0.58	−0.74	−2.0	−1.5
19	Berlin	B. D. +17° 1139	I	−0.76	+0.23	+0.03	−0.63	+0.63	−0.02	0.00	+0.63	−0.70	−3.5	−3.1
19	Berlin	B. D. +17° 1146	I	−0.95	+0.28	−0.01	+0.20	−0.20	−0.02	−0.02	−0.19	−0.88	−2.3	−1.8
19	Berlin	B. D. +17° 1147	I	−0.74	+0.22	−0.03	+0.65	−0.65	0.00	−0.01	−0.64	−0.68	−2.2	−1.8
19	Berlin	B. D. +17° 1151	I	−0.77	+0.23	−0.02	+0.61	−0.61	0.00	−0.01	−0.60	−0.71	−1.4	−1.0
19	Berlin	B. D. +17° 1153	I	−0.50	+0.15	+0.03	−0.86	+0.86	−0.02	−0.00	+0.86	−0.47	−1.4	−1.1
19	Berlin	B. D. +17° 1154	I	−0.86	+0.26	+0.02	−0.45	+0.45	−0.02	−0.01	+0.46	−0.80	−1.9	−1.4
19	Berlin	B. D. +17° 1154	I	−0.86	+0.26	+0.02	−0.45	+0.45	−0.02	−0.01	+0.46	−0.80	−2.8	−2.3
19	Berlin	B. D. +17° 1155	I	−0.89	+0.27	+0.01	−0.38	+0.38	0.02	−0.02	+0.38	−0.83	−2.0	−1.5
19	Berlin	B. D. +17° 1167	I	−0.96	+0.29	0.00	+0.14	−0.14	−0.02	−0.02	−0.14	−0.89	−1.9	−1.3
19	Berlin	B. D. +17° 1172	I	−0.87	+0.26	+0.01	−0.43	+0.43	−0.02	−0.01	+0.43	−0.81	−1.2	−0.7
19	Berlin	B. D. +17° 1177	I	−0.91	+0.27	−0.01	+0.34	−0.34	−0.01	−0.01	−0.34	−0.85	−2.4	−1.9
19	Berlin	B. D. +17° 1179	I	−0.95	+0.28	0.00	−0.20	+0.20	−0.02	0.00	+0.20	−0.88	−2.0	−1.4
19	Berlin	B. D. +17° 1183	I	−0.97	+0.29	0.00	−0.04	+0.04	−0.02	−0.01	+0.04	−0.90	−2.0	−1.4
19	Berlin	B. D. +17° 1191	I	−0.68	+0.20	+0.01	−0.71	+0.71	−0.02	−0.01	+0.72	−0.63	−2.8	−2.4
20	Berlin	B. D. +17° 1506	I	−0.65	−0.58	+0.17	+0.79	−0.81	−0.03	−0.06	−0.79	−0.58	0.0	+0.4
20	Berlin	B. D. +16° 1400	I	−1.02	−0.90	−0.09	−0.40	+0.41	−0.18	−0.07	+0.40	−0.91	+1.1	+1.7
20	Berlin	B. D. +16° 1419	I	−0.99	−0.87	+0.10	+0.45	−0.46	−0.11	−0.10	−0.43	−0.88	+2.7	+3.2
20	Berlin	B. D. +16° 1421	I	−1.01	−0.89	+0.09	+0.40	−0.41	−0.11	−0.11	−0.37	−0.90	+0.8	+1.3
20	Berlin	B. D. +16° 1423	I	−0.81	−0.72	+0.15	+0.66	−0.68	−0.05	−0.08	−0.65	−0.72	−0.1	+0.4
20	Greenwich	λ Geminor.	I	−0.51	−0.46	+0.21	+0.85	−0.88	+0.02	−0.05	−0.85	−0.46	−0.1	+0.2
20	Greenwich	λ Geminor.	EB	+0.34	+0.30	+0.23	+0.92	−0.95	+0.14	+0.03	+0.95	+0.30	+0.4	+0.3

GROUP XII—1874-1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													"	"
1885, Apr. 21	Berlin	30 B. Cancri	I	−0.96	−0.81	+0.21	+0.45	−0.49	−0.06	−0.16	−0.43	−0.87	+0.4	+0.9
22	Berlin	209 B. Cancri	I	−0.83	−0.62	+0.43	+0.51	−0.66	+0.04	−0.19	−0.47	−0.75	+0.3	+0.7
24	Prague	d Leonis	I	−0.67	−0.30	+0.71	+0.26	−0.75	+0.19	−0.22	−0.42	−0.54	+0.5	+0.9
26	Berlin	71 G. Virginis	I	−0.88	−0.05	+0.49	−0.05	−0.49	+0.10	−0.29	+0.09	−0.45	+0.2	+0.7
May 5	Cape	16 B. Capricor.	E	+0.54	−0.53	+0.40	+0.69	+0.80	+0.11	−0.08	−0.73	−0.59	−0.7	−0.8
5	Cape	β Capricor.	E	+0.48	−0.47	+0.42	+0.73	+0.85	+0.12	−0.06	−0.77	−0.52	−1.1	−1.2
19	Berlin	B. D. +12° 1931	I	−0.98	−0.79	−0.28	−0.36	+0.45	−0.23	−0.17	+0.37	−0.83	+2.2	+2.7
19	Berlin	B. D. +12° 1942	I	−0.74	−0.60	+0.47	+0.57	−0.73	+0.06	−0.16	−0.57	−0.62	+0.8	+1.2
19	Berlin	α Cancri	I	−0.63	−0.51	−0.52	−0.64	+0.82	−0.27	−0.11	+0.64	−0.53	−1.2	−0.9
22	Cape	τ Leonis	I	−0.89	−0.42	−0.31	−0.07	+0.31	−0.09	−0.28	+0.06	−0.92	+1.7	+2.2
24	Cape	θ Virginis	I	−0.95	0.00	−0.22	+0.06	+0.23	−0.10	−0.28	−0.09	−0.94	+0.2	+0.7
June 23	Cape	γ Libræ	I	−0.80	+0.53	+0.29	−0.40	−0.49	+0.11	−0.18	+0.32	−0.85	+0.1	+0.5
25	Cape	125 B. Ophiuchi	I	−0.90	+0.88	+0.03	−0.11	−0.11	+0.04	−0.08	+0.12	−0.35	−0.2	+0.3
25	Cape	164 B. Ophiuchi	I	−0.77	+0.75	+0.10	−0.52	−0.53	+0.06	−0.06	+0.52	−0.30	+0.7	+1.1
28	Cape	54 Sagittarii	E	+0.56	−0.61	−0.30	−0.72	−0.78	−0.12	−0.09	+0.74	−0.16	+0.1	0.0
July 1	Cape	θ Aquarii	E	+0.84	−0.55	+0.36	+0.19	+0.40	+0.09	−0.24	−0.25	−0.76	−2.1	−2.2
6	Berlin	B. D. + 9° 296	E	+1.00	+0.40	−0.25	+0.19	−0.31	+0.02	−0.27	−0.18	−0.86	+0.1	−0.1
6	Berlin	B. D. + 9° 301	E	+1.05	+0.42	+0.04	+0.03	−0.05	+0.09	−0.26	−0.01	−0.91	+0.8	+0.6
7	Berlin	B. D. +12° 453	E	+1.03	+0.59	+0.18	−0.21	+0.28	+0.18	−0.20	+0.21	−0.78	+0.5	+0.3
9	Berlin	α Tauri	IB	−0.90	−0.74	+0.19	−0.54	+0.57	−0.05	+0.10	+0.53	+0.40	−1.7	−1.2
21	Berlin	B. D. −16° 4230	I	−0.91	+0.64	+0.08	−0.18	−0.19	+0.05	−0.16	+0.17	−0.88	+1.2	+1.7
22	Berlin	29 Ophiuchi	I	−0.10	+0.09	−0.22	+0.96	+0.99	0.00	−0.01	−0.96	−0.08	+1.6	+1.7
22	Greenwich	29 Ophiuchi	I	−0.33	+0.30	−0.22	+0.90	+0.93	−0.06	−0.03	−0.90	−0.28	−0.4	−0.2
26	Cape	β Capricor.	IB	−0.57	+0.60	−0.43	−0.64	−0.77	−0.10	+0.09	+0.65	−0.02	+1.6	+1.9
26	Cape	β Capricor.	E	+0.74	−0.78	−0.33	−0.48	−0.58	−0.12	−0.15	+0.50	+0.02	−0.3	−0.4
Aug. 20	Greenwich	95 B. Sagittarii	I	−0.63	+0.68	+0.11	+0.70	−0.71	+0.02	+0.02	+0.71	−0.57	+0.7	+1.0
31	Berlin	B. D. +13° 565	E	+1.01	+0.56	+0.18	−0.28	+0.33	+0.17	−0.17	+0.28	−0.92	−1.1	−1.2
31	Berlin	B. D. +13° 568	E	+1.05	+0.58	+0.06	−0.09	−0.11	+0.13	−0.20	+0.11	−0.96	+1.8	+1.7
Sept. 1	Berlin	θ¹ Tauri	E	+1.08	+0.77	−0.03	+0.10	−0.11	+0.12	−0.13	−0.09	−0.99	+0.3	+0.2
1	Berlin	θ² Tauri	E	+1.06	+0.76	+0.07	−0.22	+0.23	+0.09	−0.13	+0.23	−0.97	−1.0	−1.1
1	Berlin	B. D. +15° 633	E	+0.65	+0.47	−0.25	+0.76	−0.80	−0.03	−0.09	−0.73	−0.60	+0.3	+0.2
1	Berlin	B. D. +15° 635	E	+0.85	+0.61	−0.20	+0.60	−0.63	+0.03	−0.11	−0.59	−0.78	−1.0	−1.1
1	Berlin	269 B. Tauri	E	+0.99	+0.71	−0.13	+0.39	−0.41	+0.06	−0.14	−0.37	−0.91	−0.9	−1.0
1	Berlin	85 Tauri	E	+0.58	+0.41	+0.26	−0.81	+0.85	+0.19	−0.07	+0.80	−0.53	+1.3	+1.2
1	Berlin	B. D. +15° 646	E	+0.95	+0.68	+0.15	−0.48	+0.50	+0.19	−0.11	+0.48	−0.87	+0.3	+0.2
1	Berlin	B. D. +15° 648	E	+0.71	+0.51	+0.23	−0.73	+0.76	+0.19	−0.07	+0.72	−0.65	+0.8	+0.7
1	Berlin	B. D. +15° 649	E	+0.68	+0.48	+0.23	−0.76	+0.79	+0.19	−0.08	+0.74	−0.62	+0.8	+0.7
1	Berlin	275 B. Tauri	E	+0.94	+0.67	−0.15	+0.49	−0.51	+0.05	−0.13	−0.46	−0.86	−0.3	−0.4
1	Berlin	α Tauri	IB	−0.49	−0.35	−0.26	+0.85	−0.89	−0.18	+0.06	−0.84	+0.45	−0.3	0.0
1	Berlin	B. D. +15° 653	E	+0.65	+0.47	−0.23	+0.77	−0.80	+0.02	−0.09	−0.74	−0.60	+2.2	+2.1
1	Berlin	α Tauri	E	+0.94	+0.67	+0.15	−0.48	+0.50	+0.18	−0.12	+0.47	−0.87	−1.3	−1.4
1	Greenwich	θ² Tauri	E	+1.04	+0.77	+0.04	−0.12	+0.13	+0.12	−0.14	+0.12	−0.99	+1.1	+1.0
1	Greenwich	264 B. Tauri	E	+0.69	+0.51	+0.26	−0.71	+0.76	−0.03	−0.10	−0.68	−0.65	−1.4	−1.5
1	Greenwich	85 Tauri	E	+0.71	+0.52	+0.24	−0.70	+0.74	+0.16	−0.08	+0.69	−0.57	+0.7	+0.6
1	Prague	α Tauri	IB	−0.63	−0.46	−0.26	+0.76	−0.80	−0.17	+0.07	−0.76	+0.59	−1.1	−0.8
1	Prague	α Tauri	E	+0.78	+0.58	−0.21	+0.64	−0.67	−0.01	−0.10	−0.62	−0.74	−0.6	−0.7
2	Berlin	B. D. +17° 930	E	+1.08	+0.87	−0.02	+0.17	−0.17	+0.13	−0.07	−0.15	−0.95	+0.9	+0.8
2	Berlin	B. D. +16° 788	E	+0.70	+0.57	+0.05	−0.77	+0.77	+0.13	+0.03	−0.77	−0.62	−0.6	−0.7
2	Berlin	B. D. +17° 938	E	+1.01	+0.82	−0.03	+0.38	−0.38	+0.11	−0.06	−0.37	−0.89	−0.8	−0.9
2	Berlin	B. D. +17° 942	E	+0.83	+0.67	+0.05	−0.67	+0.67	+0.15	−0.04	+0.66	−0.73	+1.2	+1.1
2	Berlin	167 H¹. Tauri	E	+0.43	+0.35	+0.06	−0.92	+0.92	+0.12	−0.03	+0.91	−0.38	−0.5	−0.5
2	Berlin	B. D. +17° 943	E	+1.10	+0.89	0.00	+0.05	−0.05	+0.14	−0.05	−0.05	−0.97	+1.8	+1.7
2	Berlin	B. D. +17° 945	E	+0.63	+0.51	−0.06	+0.82	−0.82	+0.04	−0.03	−0.80	−0.55	+0.1	0.0
2	Berlin	B. D. +17° 950	E	+0.99	+0.80	−0.02	+0.44	−0.44	+0.12	−0.04	−0.44	−0.87	−0.9	−1.0
2	Berlin	B. D. +17° 953	E	+0.52	+0.42	+0.04	−0.88	+0.88	+0.11	−0.02	+0.88	−0.46	−0.2	−0.3
5	Berlin	B. D. +14° 1932	E	+0.72	+0.64	+0.48	+0.59	−0.76	+0.25	+0.01	−0.62	−0.43	−0.8	−0.9
5	Berlin	B. D. +14° 1929	E	+1.10	+0.97	−0.07	−0.09	+0.11	+0.15	+0.19	+0.10	−0.65	+0.5	+0.4
5	Berlin	B. D. +14° 1930	E	+1.10	+0.97	−0.08	−0.10	+0.13	+0.15	+0.18	+0.11	−0.65	−0.3	−0.4
16	Berlin	B. D. −18° 4789	I	−1.10	−0.97	−0.01	−0.10	−0.10	−0.05	+0.01	+0.10	+0.65	−0.6	0.0
17	Berlin	B. D. −18° 5134	I	−0.74	+0.81	+0.16	+0.54	+0.56	+0.08	+0.05	−0.56	−0.81	−2.5	−2.1
17	Berlin	B. D. −18° 5136	I	−0.63	+0.69	+0.20	+0.67	+0.70	+0.08	−0.02	−0.70	−0.69	−0.5	−0.2
17	Berlin	B. D. −18° 5155	I	−0.80	+0.87	+0.13	+0.42	+0.44	+0.07	+0.06	−0.44	−0.87	−0.8	−0.4
17	Berlin	B. D. −18° 5157	I	−0.89	+0.97	−0.01	−0.04	−0.04	+0.06	+0.06	+0.02	−0.97	−0.9	−0.4
20	Berlin	18 Aquarii	I	−0.74	+0.74	+0.45	+0.38	+0.58	+0.15	+0.17	−0.02	−0.53	−2.2	−1.8
20	Greenwich	18 Aquarii	I	−0.78	+0.76	+0.41	+0.32	+0.52	+0.15	+0.22	−0.37	−0.55	−2.4	−2.0
21	Greenwich	150 B. Aquarii	I	−0.81	+0.67	−0.45	−0.20	−0.49	−0.12	+0.22	+0.22	−0.41	−0.7	−0.3
30	Berlin	B. D. +17° 1195	E	+1.05	+0.87	−0.05	−0.31	+0.31	+0.15	+0.02	−0.33	−0.94	+0.5	+0.4
30	Berlin	292 B. Orionis	E	+0.73	+0.61	+0.13	+0.74	−0.75	+0.11	+0.01	+0.74	−0.65	−0.1	−0.2
30	Berlin	B. D. +17° 1223	E	+0.48	+0.40	+0.15	+0.88	−0.90	+0.06	0.00	+0.89	−0.44	+1.4	+1.3
30	Berlin	B. D. +17° 1224	E	+1.10	+0.92	+0.01	+0.04	−0.04	+0.14	+0.01	+0.03	−0.99	−3.2	−3.3

GROUP XII—1874–1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1885, Sept. 30	Berlin	B. D. +17° 1226	E	+1.03	+0.86	+0.06	+0.33	−0.34	+0.14	−0.01	+0.34	−0.93	−1.7	−1.8
Oct. 1	Greenwich	λ Geminor.	IB	−1.04	−0.95	−0.06	−0.26	+0.27	−0.15	−0.08	+0.27	+0.95	−1.5	−1.0
14	Berlin	B. D. −18° 5012	I	−0.82	+0.86	−0.09	−0.41	−0.42	+0.03	+0.08	+0.41	+0.87	−1.6	−1.2
16	Berlin	B. D. −16° 5545	I	−0.89	+0.99	+0.05	+0.07	+0.09	+0.07	+0.17	−0.09	−0.99	−0.9	−0.5
Nov. 17	Greenwich	80 B. Piscium	I	−0.82	+0.34	−0.53	+0.07	−0.54	−0.19	+0.24	−0.01	−0.65	−0.6	−0.2
22	Hamburg	α Tauri	IB	−1.09	−0.63	−0.03	+0.13	−0.13	−0.16	+0.14	−0.13	+0.16	−0.2	+0.3
Dec. 2	Prague	κ Virginis	IB	−0.27	−0.03	+0.73	−0.63	−0.96	+0.25	−0.11	+0.05	+0.21	+0.3	+0.4
2	Prague	κ Virginis	E	+0.07	0.00	+0.76	−0.65	−1.00	+0.28	−0.02	+0.05	−0.71	+1.1	+1.1
28	Greenwich	θ Virginis	E	+0.90	+0.38	+0.40	−0.19	−0.44	+0.18	+0.26	+0.14	−0.90	+0.9	+0.9
1886, Jan. 14	Greenwich	85 Ceti	I	−0.86	−0.18	+0.33	−0.41	+0.52	+0.08	+0.24	+0.30	−0.78	−0.2	+0.1
14	Cape	38 Arietis	I	−1.01	−0.21	−0.01	+0.01	−0.01	−0.07	+0.26	−0.05	−0.92	−2.3	−1.9
16	Greenwich	θ^2 Tauri	EB	+0.98	+0.56	+0.09	−0.40	+0.41	+0.17	−0.13	+0.39	+0.61	−2.4	−2.4
16	Greenwich	θ^1 Tauri	EB	+1.08	+0.62	+0.02	−0.07	+0.07	+0.15	−0.14	+0.08	+0.67	−1.5	−1.5
16	Greenwich	264 B. Tauri	I	−0.91	−0.53	−0.12	+0.51	−0.53	−0.18	+0.12	−0.51	−0.57	−0.4	0.0
16	Greenwich	α Tauri	I	−0.85	−0.48	−0.12	+0.61	−0.62	−0.19	+0.10	−0.59	−0.52	−1.2	−0.9
16	Greenwich	α Tauri	EB	+0.92	+0.53	−0.09	+0.51	−0.52	+0.04	−0.12	−0.46	+0.57	+0.8	+0.8
16	Hamburg	α Tauri	I	−0.84	−0.48	−0.12	+0.62	−0.63	−0.19	+0.10	−0.60	−0.52	−1.8	−1.5
16	Hamburg	α Tauri	EB	+0.88	+0.51	−0.10	+0.57	−0.58	+0.03	−0.12	−0.53	+0.55	+1.5	+1.5
18	Greenwich	26 Geminor.	I	−1.14	−0.88	−0.09	−0.24	+0.26	−0.23	−0.03	+0.24	−0.28	−1.2	−0.8
Feb. 9	Cape	122 G. Piscium	I	−0.41	+0.06	−0.73	+0.53	−0.90	−0.27	+0.09	−0.37	−0.39	−0.4	−0.3
12	Prague	γ Tauri	I	−1.03	−0.51	+0.03	−0.11	+0.12	−0.07	+0.16	+0.08	−0.95	−0.5	−0.1
13	Cape	m Tauri	I	−0.35	−0.22	−0.03	+0.94	−0.94	−0.13	+0.02	−0.89	−0.29	−0.7	−0.6
14	Cape	71 Orionis	I	−1.05	−0.83	+0.07	+0.27	−0.28	−0.15	+0.01	−0.26	−0.84	−2.9	−2.5
Mar. 9	Greenwich	ξ^1 Ceti	I	−0.94	+0.05	−0.17	+0.18	−0.24	−0.09	+0.28	−0.16	−0.76	+0.5	+0.9
9	Greenwich	64 Ceti	EB	+0.91	−0.05	+0.23	−0.25	+0.34	+0.11	−0.25	+0.22	+0.73	−2.3	−2.3
Apr. 8	Strassburg	α Tauri	I	−0.79	−0.37	−0.07	+0.63	−0.63	−0.14	+0.11	−0.60	−0.66	−1.3	−1.0
8	Strassburg	α Tauri	EB	+0.75	+0.34	−0.07	+0.68	−0.68	−0.04	−0.11	−0.62	+0.61	−0.5	−0.4
8	Pola	α Tauri	I	−0.91	−0.42	−0.05	+0.45	−0.45	−0.12	+0.12	−0.44	−0.74	−0.1	+0.2
8	Pola	α Tauri	EB	+0.86	+0.39	−0.05	+0.54	−0.54	−0.01	−0.13	−0.50	+0.70	−0.1	0.0
10	Greenwich	26 Geminor.	I	−0.98	−0.75	+0.18	+0.41	−0.46	−0.05	−0.27	−0.25	−0.89	−0.8	−0.5
14	Strassburg	48 Leonis	I	−0.64	−0.53	−0.80	−0.12	+0.81	−0.31	−0.13	+0.34	−0.42	−1.1	−1.1
15	Greenwich	τ Leonis	I	−0.41	−0.31	−0.93	+0.08	+0.93	−0.34	−0.07	+0.10	−0.22	0.0	+0.1
May 6	Greenwich	111 Tauri	I	−0.98	−0.53	−0.04	−0.37	+0.37	−0.07	+0.08	+0.31	−0.58	+2.4	+2.7
14	Cape	46 Virginis	I	−1.05	−0.63	−0.08	+0.05	+0.09	−0.15	−0.31	−0.05	−0.67	+0.6	+0.9
16	Cape	ξ Libræ	I	−1.01	−0.17	−0.08	+0.14	+0.16	−0.12	−0.24	−0.16	−0.27	−0.1	+0.2
21	Cape	ρ Sagittarii	IB	−0.80	+0.71	+0.29	+0.42	+0.51	+0.04	+0.07	−0.43	+0.81	−1.8	−1.6
21	Cape	ρ Sagittarii	E	+0.80	−0.71	+0.29	+0.40	+0.50	+0.02	+0.07	−0.53	−0.82	−1.1	−1.0
June 6	Cape	o^1 Cancri	I	−1.05	−0.94	+0.24	+0.14	−0.28	−0.10	−0.20	−0.18	−0.79	−0.4	−0.1
10	Cape	γ Virg. (N)	I	−0.80	−0.56	+0.57	−0.29	−0.64	+0.12	−0.27	+0.03	−0.75	+2.5	+2.7
10	Cape	γ Virg. (S)	I	−1.04	−0.73	−0.05	+0.02	+0.05	−0.12	−0.31	−0.05	−0.97	+0.7	+1.0
10	Cape	γ Virg. (N)	EB	+1.00	+0.70	+0.25	−0.13	−0.28	+0.19	+0.29	+0.08	+0.93	−0.1	0.0
10	Cape	γ Virg. (S)	EB	+1.00	+0.70	+0.25	−0.13	−0.28	+0.19	+0.28	+0.08	+0.93	+0.1	+0.2
15	Cape	125 B. Ophiuchi	I	−0.85	+0.27	+0.03	+0.48	+0.48	−0.08	−0.09	−0.50	−0.22	−1.6	−1.3
July 8	Cape	66 Virginis	I	−0.70	−0.46	−0.56	+0.48	+0.73	−0.29	−0.17	−0.28	−0.68	−0.1	+0.1
Aug. 8	Strassburg	24 Scorpii	I	−0.94	+0.07	0.00	−0.20	−0.20	+0.01	−0.16	+0.15	−0.94	+2.0	+2.3
8	Strassburg	24 Scorpii	EB	+0.93	−0.07	−0.01	−0.24	−0.24	+0.15	+0.13	+0.25	+0.93	−1.4	−1.3
8	Pola	24 Scorpii	I	−0.96	+0.07	0.00	−0.13	−0.13	0.00	−0.16	+0.16	−0.96	+1.3	+1.6
8	Prague	24 Scorpii	I	−0.93	+0.07	−0.01	−0.26	−0.26	+0.02	−0.14	+0.27	−0.94	+2.0	+2.3
19	Greenwich	ν Piscium	E	+0.92	−0.49	+0.10	−0.11	+0.15	+0.03	−0.30	+0.04	−0.87	−0.6	−0.5
24	Cape	71 Orionis	E	+0.84	+0.49	−0.25	−0.56	+0.61	+0.11	−0.01	+0.66	−0.65	+0.2	+0.3
Sept. 5	Cape	164 B. Ophiuchi	I	−0.87	+0.15	+0.09	+0.41	+0.42	−0.06	−0.08	−0.44	−0.91	+0.2	+0.5
7	Greenwich	190 B. Sagittarii	I	−0.63	+0.41	+0.45	+0.57	+0.72	+0.06	+0.04	−0.59	−0.64	+2.3	+2.5
Oct. 7	Cape	18 Aquarii	I	−0.90	+0.93	0.00	0.00	0.00	+0.04	+0.22	+0.03	−0.88	−1.7	−1.4
22	Greenwich	44 Leonis	E	+0.61	+0.56	−0.83	−0.02	+0.83	−0.13	+0.18	+0.38	−0.47	0.0	+0.1
Nov. 1	Cape	ρ Sagittarii	I	−0.90	+0.54	−0.20	−0.20	−0.28	−0.02	+0.06	+0.27	−0.84	+1.0	+1.2
12	Strassburg	γ Tauri	IB	−0.92	−0.02	0.00	−0.39	+0.39	+0.03	+0.16	+0.28	+0.30	+2.1	+2.3
12	Strassburg	γ Tauri	E	+0.81	+0.02	−0.01	−0.59	+0.59	+0.13	−0.13	+0.57	−0.26	−0.1	+0.1
12	Cape	64 Tauri	E	+0.88	+0.02	+0.02	+0.48	−0.48	−0.02	−0.16	−0.44	−0.28	−0.9	−0.7
14	Cape	68 Orionis	E	+0.86	+0.35	+0.26	+0.48	−0.55	+0.06	−0.03	−0.59	−0.56	−1.0	−0.8
Dec. 3	Prague	h Aquarii	I	−0.90	+1.00	−0.05	+0.01	−0.05	+0.02	+0.29	−0.02	−1.00	−0.8	−0.6
3	Greenwich	h Aquarii	I	−0.85	+0.95	−0.31	+0.06	−0.32	−0.05	+0.27	+0.04	−0.95	−1.3	−1.1
3	Greenwich	84 Aquarii	I	−0.90	+1.00	−0.03	+0.01	−0.03	+0.03	+0.30	−0.04	−1.00	−1.4	−1.2
6	Cape	μ Piscium	I	−0.90	+0.69	−0.18	+0.21	−0.27	−0.08	+0.29	−0.14	−0.78	−0.3	−0.1
18	Greenwich	γ Virginis	E	+0.74	+0.65	+0.58	−0.43	−0.72	+0.32	+0.19	+0.11	−0.69	+3.3	+3.4
1887, Jan. 5	Greenwich	f Tauri	I	−0.90	+0.29	+0.06	−0.38	+0.38	+0.06	+0.24	+0.24	−0.68	+1.2	+1.4
5	Greenwich	f Tauri	EB	+0.80	−0.25	+0.08	−0.57	+0.58	+0.17	−0.18	+0.50	+0.61	−1.5	−1.3
6	Strassburg	θ^2 Tauri	I	−0.61	+0.03	−0.08	−0.79	+0.80	+0.10	+0.12	+0.70	−0.35	−0.2	−0.1
6	Strassburg	θ^2 Tauri	EB	+0.47	−0.02	−0.10	−0.88	+0.89	+0.17	−0.07	+0.82	+0.26	+0.4	+0.5
6	Strassburg	θ^1 Tauri	EB	+0.84	−0.04	−0.06	−0.55	+0.55	+0.15	−0.14	+0.53	+0.46	+0.7	+0.9
6	Greenwich	θ^2 Tauri	EB	+0.75	−0.03	−0.07	−0.67	+0.68	+0.17	−0.12	+0.65	+0.41	+4.9	+5.0

GROUP XII—1874-1890—Continued.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	h_0	α_0	δ_0	ε	P	n	n'
													″	″
1887, Jan. 6	Greenwich	α Tauri	I	−0.87	+0.04	+0.07	+0.50	−0.51	−0.14	+0.14	−0.50	−0.48	−1.5	−1.3
11	Cape	7 Leonis	E	+0.93	+0.76	+0.55	+0.09	−0.56	+0.28	+0.16	−0.31	−0.42	−5.6	−5.4
12	Greenwich	45 Leonis	E	+0.81	+0.70	+0.69	−0.03	−0.69	+0.32	+0.17	−0.29	−0.48	−5.6	−5.4
12	Greenwich	ρ Leonis	IB	−1.03	−0.89	+0.39	−0.03	−0.39	−0.06	−0.28	−0.20	+0.61	+1.6	+1.8
12	Greenwich	ρ Leonis	E	+1.01	+0.87	+0.43	−0.03	−0.43	+0.28	+0.24	−0.16	−0.59	+0.1	+0.3
19	Cape	78 B. Ophiuchi	E	+0.84	+0.15	−0.12	−0.51	−0.52	+0.10	+0.12	+0.52	−0.69	+0.8	+1.0
28	Greenwich	4 Ceti	I	−0.71	+0.77	−0.52	+0.31	−0.61	−0.16	+0.23	−0.03	−0.64	−0.4	−0.3
28	Greenwich	5 Ceti	I	−0.55	+0.60	−0.68	+0.40	−0.79	−0.23	+0.16	−0.02	−0.50	−1.3	−1.2
30	Pola	ν Piscium	I	−0.88	+0.75	−0.15	+0.21	−0.26	−0.04	+0.29	−0.16	−0.96	−1.1	−0.9
Feb. 1	Cape	3 B. Tauri	I	−0.84	+0.40	+0.09	−0.44	+0.45	+0.11	+0.25	+0.29	−0.88	−1.2	−1.0
4	Cape	57 Orionis	I	−0.84	−0.19	+0.28	+0.52	−0.59	−0.12	+0.04	−0.54	−0.54	−4.8	−4.6
6	Greenwich	3 Cancri	I	−1.06	−0.64	+0.26	+0.16	−0.30	−0.13	−0.11	−0.33	−0.26	−0.9	−0.7
7	Strassburg	θ Cancri	I	−0.54	−0.38	+0.84	+0.29	+0.88	+0.06	−0.10	−0.74	−0.03	−0.9	−0.8
18	Cape	246 B. Sagittarii	E	+0.72	−0.28	+0.49	+0.40	+0.75	+0.04	+0.07	−0.57	−0.55	−0.8	−0.6
Mar. 2	Prague	α Tauri	I	−0.54	+0.07	+0.15	+0.82	−0.83	−0.15	+0.08	−0.80	−0.56	−0.4	−0.3
2	Prague	α Tauri	EB	+0.57	−0.07	+0.15	+0.79	−0.81	−0.12	−0.11	−0.54	+0.59	+0.5	+0.6
2	Greenwich	α Tauri	I	−0.14	+0.02	+0.97	+0.19	−0.99	−0.01	0.00	−0.92	−0.14	−0.1	−0.1
2	Greenwich	α Tauri	EB	+0.25	−0.03	+0.95	+0.18	−0.97	−0.15	−0.06	−0.95	+0.26	+0.2	+0.3
2	Pola	α Tauri	I	−0.80	+0.10	+0.11	+0.54	−0.56	−0.11	+0.14	−0.55	−0.83	0.0	+0.2
2	Pola	α Tauri	EB	+0.83	−0.10	+0.10	+0.50	−0.51	−0.06	−0.16	−0.44	+0.86	+0.3	+0.5
8	Prague	ρ Leonis	I	−1.08	−0.90	+0.35	−0.04	−0.35	−0.10	−0.27	−0.06	−0.17	+1.2	+1.4
8	Göttingen	ρ Leonis	I	−1.07	−0.89	+0.38	−0.05	−0.38	−0.10	−0.27	−0.07	−0.17	+1.4	+1.6
8	Göttingen	ρ Leonis	EB	+0.99	+0.83	+0.51	−0.07	−0.52	+0.32	+0.21	−0.16	+0.16	+0.8	+1.0
13	Greenwich	γ Libræ	E	+1.03	+0.57	+0.01	−0.26	−0.26	+0.18	+0.22	+0.23	−0.79	−0.7	−0.5
14	Cape	φ Ophiuchi	E	+0.61	+0.23	+0.16	+0.79	+0.80	−0.08	+0.12	−0.71	−0.55	−1.9	−1.7
31	Cape	68 Orionis	I	−0.98	−0.22	−0.08	−0.11	+0.13	−0.05	+0.04	+0.12	−0.99	−2.2	−2.0
Apr. 4	Cape	α Leonis	I	−0.97	−0.81	−0.49	+0.03	+0.49	−0.28	−0.21	+0.25	−0.56	+1.6	+1.8
4	Cape	α Leonis	EB	+1.09	+0.90	+0.22	+0.01	+0.22	+0.12	+0.26	+0.13	+0.62	+0.1	+0.4
6	Cape	b Virginis	I	−1.12	−0.98	+0.17	−0.10	−0.20	−0.14	−0.33	−0.07	−0.30	−0.2	0.0
9	Cape	18 Libræ	E	+0.94	+0.62	+0.10	−0.52	−0.53	+0.29	+0.20	+0.41	−0.31	+0.2	+0.5
15	Cape	47 B. Capricor.	E	+0.80	−0.46	+0.48	+0.18	+0.52	+0.07	−0.12	−0.38	−0.85	−0.9	−0.7
15	Cape	61 B. Capricor.	E	+0.68	−0.39	−0.65	−0.22	−0.68	−0.11	−0.13	−0.59	−0.72	+4.5	+4.7
30	Greenwich	54 Cancri	I	−0.77	−0.54	−0.67	−0.18	+0.69	−0.20	−0.12	+0.51	−0.72	−2.5	−2.3
May 1	Cape	ψ Leonis	I	−1.07	−0.86	+0.03	0.00	−0.03	−0.13	−0.24	−0.07	−0.95	+0.3	+0.5
4	Prague	γ Virginis	I	−0.67	−0.58	+0.58	−0.57	−0.81	+0.16	−0.25	+0.10	−0.32	+0.9	+1.0
June 3	Cape	18 Libræ	I	−1.09	−0.79	0.00	0.00	0.00	−0.16	−0.29	−0.08	−0.54	+0.4	+0.6
13	Cape	4 Ceti	E	+0.42	−0.47	+0.71	−0.53	+0.88	+0.27	−0.10	0.00	−0.47	+0.6	+0.7
13	Cape	5 Ceti	E	+0.58	−0.64	+0.61	−0.46	+0.77	+0.23	−0.15	+0.01	−0.63	0.0	+0.2
July 1	Greenwich	η Libræ	I	−0.53	−0.33	+0.07	+0.87	+0.87	−0.29	−0.09	−0.74	−0.36	−2.7	−2.6
1	Strassburg	η Libræ	I	−0.54	−0.34	+0.08	+0.86	+0.86	−2.27	−0.09	−0.73	−0.37	−3.2	−3.1
1	Strassburg	η Libræ	EB	+0.62	+0.40	+0.07	+0.81	+0.81	−0.13	+0.17	−0.64	+0.44	−2.4	−2.2
6	Strassburg	ο Capricor.	E	+0.86	−0.36	+0.45	+0.14	+0.47	+0.09	−0.12	−0.32	−0.21	+0.9	+1.2
16	Strassburg	α Tauri	IB	−0.54	+0.24	+0.25	+0.79	−0.83	−0.17	+0.09	−0.81	+0.38	−1.4	−1.3
16	Strassburg	α Tauri	E	+0.68	−0.30	+0.22	+0.67	−0.70	−0.12	−0.15	−0.60	−0.48	+0.1	+0.3
16	Pola	α Tauri	IB	−0.74	+0.32	+0.19	+0.62	−0.65	−0.14	+0.13	−0.65	+0.52	−1.1	−1.0
29	Cape	φ Ophiuchi	I	−0.86	−0.50	+0.17	+0.52	+0.54	−0.17	−0.15	−0.56	−0.76	−0.4	−0.3
Aug. 1	Cape	190 B. Sagittarii	I	−0.85	0.00	+0.41	+0.30	+0.51	−0.03	+0.03	−0.55	−0.45	−1.7	−1.6
1	Cape	d Sagittarii	I	−0.71	0.00	−0.58	−0.37	−0.69	−0.07	+0.02	+0.62	−0.37	+1.2	+1.3
5	Cape	64 Aquarii	E	+0.89	−0.76	+0.28	−0.08	+0.29	+0.08	−0.26	−0.07	−0.29	−1.5	−1.2
8	Greenwich	29 Ceti	E	+0.55	−0.60	−0.43	+0.66	−0.79	−0.30	−0.26	−0.16	−0.52	+0.7	+0.9
14	Cape	χ^2 Orionis	E	+0.94	−0.07	+0.22	+0.26	+0.34	+0.04	−0.07	−0.38	−0.70	−0.7	−0.4
31	Greenwich	45 Capricor.	I	−0.92	+0.58	+0.15	−0.01	+0.15	+0.05	+0.24	−0.16	−0.39	−1.9	−1.8
Sept. 3	Cape	27 Piscium	E	+0.70	+0.74	+0.50	−0.40	+0.64	+0.19	−0.21	−0.01	−0.17	+1.5	+1.7
3	Cape	29 Piscium	E	+0.88	−0.93	+0.19	−0.16	+0.25	+0.06	−0.30	+0.04	−0.21	−0.4	−0.1
13	Cape	θ Cancri	E	+0.77	+0.32	−0.67	−0.16	+0.69	−0.01	+0.12	+0.59	−0.50	0.0	−0.2
Oct. 12	Strassburg	α Leonis	IB	−1.06	−0.71	−0.20	+0.04	+0.21	−0.20	−0.24	+0.06	+0.73	−0.2	−0.1
12	Greenwich	α Leonis	IB	−1.09	−0.72	−0.04	+0.01	+0.04	−0.17	−0.26	−0.02	+0.75	−0.5	−0.4
12	Greenwich	α Leonis	E	+1.09	+0.72	−0.03	+0.01	+0.03	+0.14	+0.27	+0.06	−0.75	−1.0	−0.7
26	Greenwich	70 Aquarii	I	−0.89	+0.66	+0.22	−0.09	+0.24	+0.09	+0.30	−0.15	−0.87	−1.1	−1.0
28	Greenwich	54 B. Ceti	I	−0.65	+0.69	+0.46	−0.52	+0.69	+0.27	+0.29	−0.02	−0.43	−1.1	−1.1
Nov. 7	Cape	δ Cancri	E	+0.97	+0.40	−0.27	−0.03	+0.27	+0.03	−0.16	+0.23	−0.96	−1.4	−1.1
21	Cape	42 Capricor.	I	−0.75	+0.29	−0.61	+0.08	−0.62	−0.16	+0.15	+0.35	−0.76	−0.3	−0.3
22	Cape	σ Aquarii	I	−0.63	+0.40	−0.68	+0.25	−0.73	−0.19	+0.15	+0.30	−0.68	+0.2	+0.2
22	Cape	58 Aquarii	I	−0.77	+0.50	+0.51	−0.19	+0.55	+0.16	+0.27	−0.24	−0.84	−3.6	−3.6
24	Cape	4 Ceti	I	−0.87	+0.85	+0.18	−0.19	+0.26	+0.11	+0.34	−0.05	−0.91	−0.1	−0.1
24	Cape	5 Ceti	I	−0.89	+0.87	+0.08	−0.09	+0.12	+0.07	+0.34	−0.05	−0.93	−1.3	−1.3
24	Cape	19 B. Ceti	I	−0.80	+0.78	−0.31	+0.33	−0.45	−0.12	+0.28	−0.04	−0.84	−0.2	−0.2
Dec. 17	Cape	ρ Capricor.	I	−1.01	+0.05	−0.01	0.00	−0.01	−0.07	+0.14	+0.01	−0.51	−1.5	−1.5
17	Cape	34 B. Capricor.	I	−0.98	+0.05	+0.25	+0.04	+0.26	−0.04	+0.15	−0.28	−0.49	−0.1	−0.1
27	Greenwich	75 Tauri	I	−0.92	+0.72	−0.07	−0.15	+0.16	+0.04	+0.21	+0.08	−0.48	−0.1	−0.1

GROUP XII—1874-1890 Continued.

Date.	Place.	Star.	Ph.	λ	κ	ϑ	i	b_0	a_0	δ_0	ϵ	P	n	n'
													″	″
1888, Jan. 15	Cape	μ Capricor.	I	−0.97	+0.37	+0.06	−0.02	+0.06	−0.02	+0.24	−0.10	−0.43	−1.0	−1.0
27	Cape	85 Geminor.	I	−0.48	−0.02	−0.86	−0.02	+0.88	−0.12	−0.04	+0.77	−0.04	+0.7	+0.7
Mar. 9	Cape	44 Capricor.	E	+0.73	−0.16	−0.63	+0.15	−0.65	−0.13	−0.20	+0.44	−0.43	−0.1	+0.2
9	Cape	45 Capricor.	E	+0.49	−0.11	+0.83	−0.20	+0.86	+0.21	−0.09	−0.55	−0.29	−2.5	−2.0
18	Cape	∂ Tauri	I	−0.73	+0.67	−0.28	−0.52	+0.59	+0.14	+0.18	+0.46	−0.77	−1.0	−1.0
25	Cape	*l* Leonis	I	−0.24	−0.14	−0.83	+0.52	+0.98	−0.32	−0.01	+0.35	−0.07	+0.2	+0.2
July 17	Cape	ξ Libræ	I	−0.84	−0.78	+0.15	+0.61	+0.63	−0.32	−0.20	−0.45	−0.76	−1.7	−1.7
17	Cape	18 Libræ	I	−0.49	−0.45	−0.22	−0.87	−0.89	+0.20	−0.11	+0.57	−0.44	+1.0	+1.0
20	Cape	16 G. Sagittarii	I	−1.08	−0.77	−0.14	−0.09	−0.17	−0.16	−0.09	+0.10	−0.63	−0.3	−0.3
21	Cape	36 Sagittarii	I	−0.63	−0.38	−0.77	−0.26	−0.81	−0.09	−0.01	+0.76	−0.21	+1.7	+1.7
21	Cape	ξ Sagittarii	I	−0.59	−0.35	+0.79	+0.27	+0.84	−0.09	+0.01	−0.77	−0.20	−4.5	−4.5
21	Cape	ξ Sagittarii	EB	+0.59	+0.35	+0.79	+0.26	+0.84	+0.09	+0.02	−0.86	+0.20	−4.3	−4.0
23	Cape	19 Capricor.	E	+1.04	+0.21	−0.09	+0.01	−0.09	+0.14	+0.17	+0.07	+0.04	+0.3	+0.8
23	Cape	21 Capricor.	E	+0.79	+0.16	−0.64	+0.12	−0.66	−0.02	−0.16	+0.52	+0.03	−3.9	−3.5
23	Cape	θ Capricor.	E	+1.04	+0.21	−0.09	+0.02	−0.09	+0.10	−0.19	+0.08	+0.04	+2.3	+2.8
25	Cape	70 Aquarii	E	+0.48	0.00	−0.70	+0.53	−0.88	−0.23	−0.21	+0.37	−0.18	+0.4	+0.6
28	Cape	35 Ceti	E	+0.91	−0.79	−0.03	+0.11	−0.12	−0.05	−0.37	+0.04	−0.85	−0.7	−0.3
Aug. 17	Cape	121 B. Sagittarii	I	−0.63	−0.43	+0.75	+0.29	+0.81	−0.11	0.00	−0.75	−0.46	−2.2	−2.2
20	Pola	γ Capricor.	I	−0.94	−0.08	+0.35	−0.14	+0.38	+0.01	+0.22	−0.31	−0.25	−4.5	−4.5
Sept. 13	Cape	15 Sagittarii	I	−0.96	−0.79	−0.37	−0.18	−0.42	−0.10	−0.07	+0.34	−0.91	+4.8	+4.8
13	Cape	21 Sagittarii	I	−0.67	−0.51	−0.71	−0.30	−0.77	−0.04	+0.04	+0.72	−0.64	+4.0	+4.0
16	Pola	30 Capricor.	I	−1.00	−0.26	+0.04	−0.01	+0.04	−0.07	+0.21	−0.09	−0.78	+1.7	+1.6
Oct. 9	Cape	29 Ophiuchi	I	−0.79	−0.71	−0.52	−0.45	−0.69	0.00	−0.14	+0.59	−0.58	+1.2	+1.2
13	Pola	20 Capricor.	I	−0.87	−0.37	−0.49	+0.12	−0.50	−0.15	+0.16	+0.30	−0.84	+3.0	+2.9
15	Cape	70 Aquarii	I	−0.94	+0.05	−0.15	+0.14	−0.21	−0.10	+0.29	+0.03	−0.77	+0.6	+0.5
20	Greenwich	μ Ceti	IB	−0.77	+0.79	−0.13	−0.51	+0.53	+0.18	+0.31	+0.25	+0.14	−0.4	−0.5
Nov. 15	Cape	ν Piscium	I	−0.72	+0.58	+0.01	−0.61	+0.61	+0.23	+0.34	+0.15	−0.45	+1.5	+1.4
Dec. 20	Cape	μ Cancri	E	+0.93	−0.53	−0.05	+0.01	+0.05	+0.01	+0.10	+0.05	−0.55	−0.8	−0.3
1889, Jan. 8	Cape	35 Ceti	I	−0.34	+0.19	+0.08	−0.93	+0.93	+0.34	+0.21	+0.20	−0.36	+0.8	+0.8
12	Göttingen	64 Tauri	I	−0.80	+0.89	+0.32	+0.33	−0.46	−0.08	+0.21	−0.50	−0.65	−0.6	−0.7
14	Cape	141 Tauri	I	−0.38	+0.39	+0.84	+0.35	−0.91	−0.07	+0.02	−0.87	−0.17	−0.9	−0.9
Feb. 5	Cape	ν Piscium	I	−0.40	+0.26	−0.07	−0.90	+0.90	+0.33	+0.22	+0.31	−0.38	−0.9	−0.9
9	Greenwich	*i* Tauri	I	−0.51	+0.56	−0.66	−0.51	+0.83	+0.17	+0.13	+0.74	−0.52	−1.3	−1.3
12	Greenwich	63 Geminor.	I	−0.55	+0.45	+0.81	+0.02	−0.81	+0.03	−0.03	−0.81	−0.32	−0.5	−0.6
Mar. 10	Cape	η Geminor.	I	−0.79	+0.84	−0.46	−0.13	+0.48	+0.05	+0.07	+0.44	−0.85	+1.4	+1.3
11	Cape	44 Geminor.	I	−0.46	+0.42	−0.86	−0.07	+0.86	−0.01	0.00	+0.79	−0.45	−0.2	−0.2
23	Cape	14 Sagittarii	E	+1.06	+0.97	−0.10	−0.03	−0.11	+0.16	+0.07	+0.18	−1.00	−3.1	−2.6
Apr. 20	Cape	30 Sagittarii	E	+1.03	+0.90	+0.30	+0.03	+0.30	+0.15	+0.01	−0.21	−0.87	−4.3	−3.8
20	Cape	31 Sagittarii	E	+0.79	+0.68	−0.68	−0.07	−0.69	+0.13	0.00	+0.74	−0.66	−1.8	−1.4
June 5	Cape	167 B. Leonis	I	−0.89	+0.21	−0.23	+0.26	+0.35	−0.14	−0.27	+0.06	−0.94	−0.7	−0.8
5	Cape	46 Leonis	I	−0.77	+0.18	+0.38	−0.45	−0.59	+0.15	−0.28	−0.22	−0.81	−0.1	−0.2
10	Cape	13 Libræ	I	−0.94	−0.70	+0.46	+0.27	+0.53	−0.35	−0.25	−0.38	−0.43	−2.7	−2.8
July 19	Cape	64 Ceti	E	+0.94	−0.44	−0.02	−0.05	+0.05	+0.05	−0.36	+0.10	−1.00	−1.5	−1.0
Aug. 8	Cape	168 B. Sagittarii	I	−0.52	−0.44	+0.89	−0.02	+0.89	−0.10	+0.01	−0.90	−0.26	−4.2	−4.3
Sept. 4	Cape	ν² Sagittarii	I	−0.50	−0.45	+0.89	−0.05	+0.89	−0.08	0.00	−0.91	−0.40	−3.1	−3.1
16	Greenwich	ζ Tauri	IB	−0.67	+0.73	−0.64	−0.18	+0.67	+0.10	+0.12	+0.57	+0.75	−2.2	−2.3
30	Cape	190 B. Ophiuchi	I	−1.03	−0.92	−0.26	−0.08	−0.27	−0.12	−0.15	+0.18	−0.90	+1.0	+0.9
Oct. 5	Greenwich	56 Aquarii	I	−0.78	−0.46	−0.39	+0.56	−0.68	−0.31	+0.20	+0.24	−0.52	+0.3	+0.2
29	Greenwich	208 B. Sagittarii	I	−1.07	−0.98	−0.18	+0.03	−0.18	−0.17	+0.03	+0.08	−0.89	+0.8	+0.7
Nov. 29	Cape	74 Aquarii	I	−1.00	−0.64	−0.12	+0.24	−0.27	−0.22	+0.31	+0.12	−0.96	+1.3	+1.2
Dec. 1	Cape	15 Ceti	I	−0.25	−0.06	+0.05	+0.97	−0.97	−0.41	+0.01	−0.14	−0.24	−1.7	−1.7
29	Cape	33 Ceti	I	−0.65	−0.11	−0.17	−0.73	+0.75	+0.25	+0.33	+0.12	−0.67	0.0	−0.1
31	Greenwich	85 Ceti	I	−0.69	+0.20	+0.41	+0.54	−0.68	−0.27	+0.22	−0.62	−0.67	+0.1	0.0
31	Cape	38 Arietis	I	−0.70	+0.21	+0.41	+0.52	−0.66	−0.25	+0.22	−0.44	−0.68	−1.0	−1.1
1890, Jan. 3	Göttingen	*l* Tauri	I	−0.38	+0.34	−0.87	−0.26	+0.91	+0.17	+0.10	+0.83	−0.22	−1.4	−1.4
15	Greenwich	ο Libræ	E	+0.97	−0.49	+0.23	+0.25	+0.34	0.00	+0.34	−0.18	−0.83	+1.8	+2.3
Feb. 7	Göttingen	ν Virginis	I	−0.94	+0.41	0.00	−0.01	−0.01	−0.02	−0.38	−0.05	+0.64	−3.3	−3.4
7	Göttingen	ν Virginis	E	+0.92	−0.40	+0.03	−0.22	−0.23	+0.12	+0.35	+0.03	−0.62	+2.3	+2.8
7	Greenwich	ν Virginis	IB	−0.94	+0.41	−0.01	+0.09	+0.09	−0.06	−0.37	−0.01	+0.64	−3.0	−3.1
7	Greenwich	ν Virginis	E	+0.94	−0.41	+0.01	−0.07	−0.07	+0.06	+0.38	+0.0	−0.64	+1.8	+2.3
12	Cape	θ Libræ	E	+0.88	+0.58	−0.45	−0.28	−0.53	+0.25	+0.21	+0.50	−0.83	−2.0	−1.6
14	Göttingen	4 Sagittarii	E	+0.51	+0.44	−0.89	−0.03	−0.89	+0.16	+0.05	+0.92	−0.37	−0.7	−0.4
Mar. 14	Cape	117 B. Sagittarii	E	+0.97	+0.86	−0.43	+0.06	−0.43	+0.17	+0.02	+0.51	−0.85	−1.7	−1.2
Apr. 7	Cape	30 Libræ	E	+0.96	+0.43	−0.31	−0.23	−0.39	+0.25	+0.27	+0.35	−0.59	+0.8	+1.3
7	Greenwich	32 Libræ	E	+0.69	+0.31	−0.62	−0.43	−0.75	+0.32	+0.17	+0.58	−0.42	−0.8	−0.5
15	Cape	ψ³ Aquarii	E	+1.06	+0.72	−0.03	+0.14	−0.15	+0.11	−0.38	+0.12	−0.67	−0.3	+0.2
28	Cape	η Leonis	I	−0.76	+0.73	−0.27	+0.48	+0.55	−0.16	−0.22	+0.25	−0.77	−3.1	−3.2
30	Greenwich	ν Virginis	I	−0.75	+0.42	+0.04	−0.62	−0.62	+0.20	−0.36	−0.14	−0.51	−0.4	−0.5
30	Greenwich	ν Virginis	EB	+0.55	−0.44	+0.05	−0.82	+0.82	+0.35	+0.16	−0.06	+0.37	−5.3	−5.0
May 3	Greenwich	95 Virginis	I	−0.18	−0.02	−0.81	+0.56	+0.99	−0.40	+0.02	−0.52	−0.01	−1.2	−1.2

GROUP XII—1874-1890—Continued.

Date.		Place.	Star.	Ph.	λ	κ	i''	i	b_0	a_0	δ_0	ι	P	n	n'
														″	″
1890, May	3	Greenwich	κ Virginis	I	−0.32	−0.03	+0.57	+0.76	+0.95	−0.40	−0.05	−0.52	−0.02	+0.7	+0.7
	9	Cape	329 B. Sagittarii	E	+0.79	+0.71	−0.60	+0.34	−0.69	+0.06	−0.09	+0.48	−0.66	−3.0	−2.6
	30	Cape	566 B. Virginis	I	−0.89	+0.04	+0.23	+0.40	+0.47	−0.12	−0.14	−0.28	−0.54	+0.7	+0.6
June	2	Greenwich	ω Ophiuchi	IB	−0.92	−0.51	+0.53	+0.16	+0.55	−0.28	−0.19	−0.57	−0.03	−1.3	−1.4
	4	Cape	24 Sagittarii	E	+1.11	+0.90	+0.09	−0.02	+0.09	+0.21	+0.05	0.00	−0.40	+1.3	+1.9
	5	Cape	53 Sagittarii	E	+0.87	+0.76	−0.56	+0.28	−0.63	+0.12	−0.07	+0.65	−0.46	−1.7	−1.3
	5	Cape	274 B. Sagittarii	E	+0.86	+0.76	−0.57	+0.28	−0.63	+0.12	−0.06	+0.65	−0.46	−0.6	−0.2
	6	Cape	17 Capricor.	E	+1.10	+0.99	+0.12	−0.11	+0.16	+0.24	−0.18	−0.11	−0.73	−1.3	−0.7
	29	Greenwich	56 B. Scorpii	EB	+1.08	+0.52	+0.07	+0.03	+0.07	+0.15	+0.28	+0.01	+0.51	−1.7	−1.2
	29	Greenwich	β Scorpii	EB	+1.08	+0.52	+0.07	+0.03	+0.07	+0.15	+0.28	+0.01	+0.51	−5.7	−5.2
	29	Göttingen	β Scorpii	EB	+1.08	+0.52	+0.05	+0.02	+0.05	+0.16	+0.29	+0.03	+0.50	−3.0	−2.5
July	12	Göttingen	ε Tauri	E	+0.46	−0.18	−0.84	−0.23	+0.87	+0.22	−0.10	+0.85	−0.38	−3.1	−2.9
	21	Cape	ω Virginis	I	−0.88	+0.66	0.00	+0.24	+0.24	−0.09	−0.36	−0.05	−0.80	−0.3	−0.4
Aug.	26	Cape	108 B. Sagittarii	I	−1.05	−0.86	−0.29	+0.14	−0.32	−0.21	+0.03	+0.23	−0.67	+0.6	+0.7
Sept.	1	Cape	f Piscium	E	+1.02	+0.53	−0.16	−0.30	+0.34	+0.31	−0.35	+0.04	−0.47	−0.7	−0.2
	6	Greenwich	394 B. Tauri	E	+0.82	−0.49	+0.47	−0.04	−0.47	−0.04	−0.12	−0.38	−0.87	+1.0	+1.4
	20	Greenwich	24 Ophiuchi	I	−0.80	−0.41	−0.62	−0.05	−0.62	+0.04	−0.18	+0.52	−0.77	−0.7	−0.8
	27	Greenwich	33 Piscium	IB	−1.02	−0.72	−0.07	−0.42	+0.42	−0.02	−0.41	−0.11	−0.18	+4.7	+4.6
	30	Cape	31 Arietis	E	+1.00	+0.27	+0.23	+0.19	−0.30	+0.03	−0.39	−0.11	−0.37	+0.6	+1.1
Oct.	24	Cape	351 B. Aquarii	I	−0.32	−0.25	+0.05	+0.96	−0.96	−0.44	+0.02	+0.32	−0.20	+0.6	+0.6
	27	Greenwich	ξ¹ Ceti	IB	−0.97	−0.35	+0.29	+0.29	−0.41	−0.31	+0.33	−0.29	−0.15	+0.2	+0.1
Nov.	17	Cape	36 B. Capricor.	I	−0.96	−0.85	−0.30	+0.33	−0.45	−0.22	+0.14	+0.30	−0.83	+2.5	+2.4
	20	Cape	ψ³ Aquarii	I	−1.06	−0.93	0.00	+0.13	−0.13	−0.23	+0.37	−0.04	−0.96	+2.3	+2.2
	21	Kasan	33 Piscium	I	[illegible]9	−0.65	+0.14	+0.66	−0.67	−0.40	+0.26	−0.04	−0.68	+2.5	+2.4
Dec.	1	Cape	79 Cancri	E	+[illegible]5	−0.27	+0.53	+0.80	−0.96	+0.21	+0.04	−0.69	−0.24	−0.9	−0.8
	20	Kasan	ν Piscium	I	−0.92	−0.57	−0.29	−0.34	+0.45	+0.08	+0.35	+0.09	−0.87	+3.4	+3.3
	23	Cape	53 Tauri	I	−0.52	+0.03	−0.84	−0.13	+0.85	+0.16	+0.18	+0.73	−0.30	−0.9	−1.0

GROUP XIII—1891-1908.

1891, Jan.	4	Greenwich	2 Libræ	E	+0.92	+0.77	+0.42	+0.32	+0.53	−0.05	+0.38	−0.24	−0.73	−1.4	−0.9
Feb.	12	Göttingen	29 Ceti	I	−0.98	−0.74	−0.26	−0.38	+0.46	+0.02	+0.40	+0.03	−0.64	+1.0	+0.9
	17	Greenwich	121 Tauri	I	−0.77	+0.17	+0.57	−0.12	−0.58	−0.11	+0.11	−0.64	−0.78	+2.2	+2.1
	20	Cape	λ Cancri	I	−0.72	+0.62	−0.40	+0.47	+0.61	−0.11	−0.12	+0.47	−0.44	−1.2	−1.3
	21	Cape	90 H¹. Cancri	I	−0.88	+0.89	−0.11	+0.21	+0.24	−0.07	−0.23	+0.08	−0.36	−3.0	−3.1
Mar.	15	Cape	56 Tauri	I	−0.43	−0.07	−0.90	−0.06	+0.90	+0.17	+0.14	−0.78	−0.38	−1.2	−1.2
	19	Cape	ω¹ Cancri	I	−0.18	−0.13	+0.67	−0.71	−0.98	+0.14	−0.05	−0.88	−0.17	−1.4	−1.4
	19	Cape	ω² Cancri	I	−0.90	+0.67	−0.09	+0.09	+0.13	−0.03	−0.13	+0.06	−0.91	−0.6	−0.6
	26	Hamburg	l Virginis	IB	−0.81	+0.60	−0.33	−0.36	−0.49	+0.19	−0.41	+0.20	+0.30	−3.3	−3.3
	26	Greenwich	l Virginis	E	+0.82	−0.61	−0.31	−0.34	−0.46	+0.21	+0.33	+0.25	−0.30	+1.7	+2.1
	28	Greenwich	ν Libræ	E	+0.78	−0.23	−0.53	−0.22	−0.57	+0.24	+0.26	+0.48	−0.59	−0.2	+0.2
Apr.	15	Kasan	κ Geminor.	EB	+0.93	−0.60	+0.06	−0.06	−0.10	+0.05	+0.30	−0.04	+1.00	−0.4	0.0
	18	Greenwich	42 Leonis	I	−0.84	+0.91	−0.05	+0.36	+0.36	−0.12	−0.30	+0.13	−0.79	+0.2	+0.2
	20	Göttingen	ν Virginis	I	−0.87	+0.95	−0.07	−0.26	−0.27	+0.11	−0.42	−0.07	−0.59	−4.7	−4.7
	20	Greenwich	ν Virginis	EB	+0.86	−0.93	−0.08	−0.31	−0.32	+0.14	+0.37	+0.03	+0.58	−1.2	−0.9
	25	Göttingen	41 Libræ	E	+0.96	−0.16	+0.18	+0.04	+0.18	+0.02	+0.31	−0.07	−0.45	+2.7	+3.1
	25	Göttingen	κ Libræ	IB	−0.85	+0.14	+0.48	+0.10	+0.49	−0.21	−0.24	−0.50	+0.40	−5.4	−5.4
	25	Göttingen	κ Libræ	E	+0.95	−0.16	+0.20	+0.04	+0.20	+0.01	+0.31	+0.05	−0.45	+1.2	+1.6
	25	Hamburg	κ Libræ	E	+0.96	−0.16	+0.15	+0.03	+0.15	+0.03	+0.31	0.00	−0.46	+1.3	+1.7
May	4	Cape	54 B. Ceti	E	+1.11	+0.93	+0.01	+0.03	−0.03	+0.20	−0.43	+0.08	−0.65	−0.5	−0.1
	10	Göttingen	121 Tauri	I	−0.69	+0.06	−0.70	+0.21	+0.73	+0.02	+0.10	+0.66	−0.32	−2.8	−2.8
	14	Cape	ξ Cancri	I	−0.88	+0.80	−0.11	+0.24	+0.26	−0.08	−0.24	+0.12	−0.94	0.0	0.0
	14	Cape	79 Cancri	I	−0.91	+0.82	0.00	+0.01	+0.01	−0.02	−0.25	−0.08	−0.96	−1.8	−1.8
	28	Cape	φ Capricor.	E	+0.81	+0.68	−0.24	+0.59	−0.64	−0.03	−0.23	+0.53	−0.73	−1.9	−1.6
June	12	Kasan	ι Leonis	I	−0.58	+0.62	+0.02	−0.77	−0.77	+0.26	−0.29	−0.26	−0.60	−0.2	−0.2
July	18	Cape	157 B. Ophiuchi	I	−1.02	−0.07	+0.11	−0.03	+0.12	−0.15	−0.16	−0.19	−0.53	+0.6	+0.6
	18	Cape	Pi. XVII 31	I	−0.57	−0.04	+0.80	−0.22	+0.83	−0.20	−0.07	−0.85	−0.30	−3.8	−3.8
	18	Cape	39 Ophiuchi	I	−0.56	−0.04	+0.81	−0.22	+0.84	−0.20	−0.07	−0.85	−0.29	−4.0	−4.0
	22	Cape	ι Capricor.	E	+0.75	+0.58	+0.18	−0.72	+0.75	+0.37	−0.15	−0.49	−0.22	−2.1	−1.8
Aug.	14	Cape	22 Ophiuchi	I	−0.97	+0.04	+0.22	−0.05	+0.23	−0.15	−0.19	−0.29	−0.85	+2.2	+2.2
	14	Greenwich	26 Ophiuchi	I	−0.78	+0.03	+0.60	−0.14	+0.62	−0.19	−0.15	−0.65	−0.69	−2.5	−2.5
	18	Cape	χ Capricor.	I	−1.13	−0.79	−0.02	+0.04	−0.05	−0.26	+0.25	+0.01	−0.20	−0.1	−0.1
	20	Cape	ψ¹ Aquarii	E	+0.86	+0.75	+0.17	+0.64	−0.66	−0.07	−0.37	+0.22	−0.20	−1.5	−1.2
	20	Cape	ψ² Aquarii	E	+0.91	+0.79	−0.16	−0.59	+0.61	+0.45	−0.26	−0.10	−0.21	−1.6	−1.3
	24	Cape	σ Arietis	E	+0.27	+0.19	−0.92	−0.30	+0.97	+0.39	−0.01	+0.67	−0.23	−3.7	−3.6
Oct.	12	Cape	φ Capricor.	I	−0.86	−0.61	−0.15	+0.57	−0.59	−0.30	+0.19	+0.35	−0.71	+1.8	+1.9
	14	Cape	ψ¹ Aquarii	I	−0.74	−0.64	+0.22	+0.72	−0.76	−0.46	+0.19	+0.15	−0.39	−2.2	−2.1
	14	Cape	ψ² Aquarii	I	−0.98	−0.83	−0.15	−0.49	+0.51	−0.01	+0.40	−0.17	−0.51	−0.1	0.0
	15	Göttingen	30 Piscium	I	−0.62	−0.55	−0.40	−0.74	+0.84	+0.24	+0.32	−0.12	−0.26	−0.7	−0.7
	15	Greenwich	30 Piscium	I	−0.72	−0.63	−0.37	−0.69	+0.78	+0.18	+0.35	−0.12	−0.30	−0.8	−0.4

GROUP XIII—1891–1908 Continued.

Date.	Place.	Star.	Ph.	λ	κ	i''	i	b_0	a_0	δ_0	t	l'	n	n'
													″	″
1891, Nov. 6	Cape	σ Sagittarii	I	−0.95	−0.23	+0.20	−0.20	+0.28	−0.10	+0.54	−0.26	−0.84	+1.1	+1.2
6	Cape	σ Sagittarii	EB	+1.02	+0.24	+0.11	+0.11	−0.15	+0.14	−0.28	+0.18	+0.87	−1.3	−1.0
7	Göttingen	ω Sagittarii	I	−1.00	−0.44	+0.10	−0.16	+0.18	−0.10	+0.12	−0.25	−0.94	+3.8	+3.9
10	Göttingen	τ Aquarii	I	−0.41	−0.35	+0.18	+0.91	−0.92	−0.43	+0.07	+0.33	−0.35	+0.7	+0.7
10	Göttingen	τ Aquarii	EB	+0.70	+0.61	+0.15	+0.75	−0.76	−0.17	−0.32	+0.35	+0.62	−5.3	−5.1
10	Kasan	69 Aquarii	I	−1.05	−0.90	−0.04	−0.23	+0.24	−0.10	+0.40	−0.17	−0.91	+3.0	+3.1
10	Kasan	τ Aquarii	I	−0.98	−0.85	+0.08	+0.41	−0.42	−0.33	+0.32	+0.09	−0.86	+2.7	+2.8
10	Hamburg	τ Aquarii	I	−0.26	−0.22	+0.19	+0.96	−0.97	−0.42	+0.02	+0.29	−0.22	+0.5	+0.5
10	Padua	τ Aquarii	I	−0.76	−0.67	+0.13	+0.70	−0.71	−0.40	+0.23	+0.23	−0.68	+0.9	+1.0
10	Padua	τ Aquarii	EB	+0.98	+0.85	+0.08	+0.41	−0.42	+0.01	−0.40	+0.23	+0.85	−3.3	−3.0
19	Cape	υ Geminor.	E	+0.86	−0.14	+0.28	−0.39	−0.48	+0.13	+0.08	−0.46	−0.65	+0.1	+0.4
1892, Jan. 19	Hamburg	γ Virginis	IB	−0.76	+0.86	+0.37	+0.36	+0.52	−0.23	−0.33	−0.11	+0.81	−3.6	−3.5
19	Prague	γ Virginis	IB	−0.78	+0.86	+0.36	+0.36	+0.51	−0.23	−0.32	+0.11	−0.81	−3.0	−2.9
19	Göttingen	γ Virginis	IB	−0.74	+0.82	+0.41	+0.40	+0.57	−0.27	−0.31	−0.12	+0.77	−3.5	−3.4
Feb. 1	Greenwich	376 B. Aquarii	I	−0.94	−0.80	+0.28	+0.45	−0.53	−0.42	+0.32	0.00	−0.56	+1.7	+1.8
7	Greenwich	118 Tauri (S.)	I	−0.96	−0.41	−0.28	+0.16	+0.33	−0.08	+0.13	+0.27	−0.82	−1.2	−1.1
7	Greenwich	118 Tauri (N.)	I	−0.96	−0.42	−0.28	+0.16	+0.32	−0.08	+0.13	+0.27	−0.83	−0.1	0.0
23	Cape	σ Sagittarii	E	+1.00	+0.07	+0.08	−0.10	+0.13	+0.12	−0.03	−0.13	−0.70	+2.0	+2.3
Mar. 8	Greenwich	4 Cancri	I	−0.53	+0.03	+0.34	−0.77	−0.84	+0.07	−0.10	−0.79	−0.47	+0.8	+0.9
16	Hamburg	λ Virginis	E	+0.76	−0.79	−0.52	−0.14	−0.54	+0.22	+0.29	+0.35	−0.56	−0.1	+0.1
Apr. 2	Greenwich	139 Tauri	I	−0.82	−0.36	+0.47	+0.38	+0.61	−0.07	+0.07	+0.55	−0.75	−1.4	−1.2
May 8	Göttingen	θ Virginis	I	−0.82	+0.90	+0.34	+0.20	+0.40	−0.18	−0.36	−0.17	−0.47	−1.5	−1.3
8	Göttingen	θ Virginis	EB	+0.88	−0.97	+0.20	−0.12	+0.23	−0.09	+0.45	−0.01	+0.51	−1.5	−1.3
13	Cape	26 Ophiuchi	E	+0.74	−0.46	+0.53	−0.28	+0.60	−0.07	+0.17	−0.52	−0.35	−1.3	−1.1
June 8	Hamburg	δ Scorpii	I	−0.44	+0.37	−0.85	+0.24	−0.88	+0.22	−0.17	+0.74	−0.13	−0.7	−0.6
14	Santiago	κ Capricor.	E	+0.77	+0.36	+0.05	+0.65	−0.65	−0.10	−0.28	+0.45	−0.65	−1.6	−1.4
July 4	Cape	α Libræ	I	−0.86	+0.92	−0.30	0.00	−0.30	+0.09	−0.39	+0.19	−0.82	0.0	+0.2
6	Cape	ρ Ophiuchi (N.)	I	−0.83	+0.69	+0.41	−0.17	+0.45	−0.15	−0.20	−0.37	−0.53	−0.2	0.0
6	Cape	ρ Ophiuchi (S.)	I	−0.83	+0.69	+0.42	−0.17	+0.45	−0.15	−0.20	−0.37	−0.53	−0.8	−0.6
11	Cape	χ Capricor.	E	+0.29	+0.08	−0.05	+0.96	−0.96	−0.22	−0.13	+0.75	−0.12	−1.0	−0.9
13	Santiago	ψ² Aquarii	IB	−1.04	−0.72	−0.08	−0.13	+0.15	−0.10	+0.45	−0.05	+0.75	−3.3	−3.0
13	Santiago	ψ² Aquarii	E	+1.02	+0.71	−0.14	−0.23	+0.27	+0.28	−0.40	−0.06	−0.74	−3.4	−3.2
19	Hamburg	72 Tauri	IB	−0.84	−0.66	+0.58	−0.25	−0.63	−0.29	+0.18	−0.64	+0.64	−1.3	−1.1
19	Hamburg	υ Tauri	E	+1.07	+0.82	+0.11	−0.05	−0.12	+0.16	−0.26	−0.80	−0.80	+0.2	+0.4
19	Hamburg	72 Tauri	E	+0.92	+0.71	+0.46	−0.20	−0.51	+0.04	−0.24	−0.37	−0.70	−0.9	−0.7
Aug. 2	Santiago	ρ Ophiuchi	I	−0.76	+0.63	−0.52	+0.24	−0.57	+0.09	−0.23	+0.48	−0.75	+1.1	+1.3
3	Cape	88 B. Ophiuchi	I	−0.36	+0.34	−0.78	+0.50	−0.92	+0.14	−0.10	+0.87	−0.32	−2.4	−2.3
4	Santiago	66 B. Sagittarii	I	−0.92	+0.39	+0.19	−0.24	+0.31	−0.08	−0.03	−0.36	−0.64	+3.7	+3.9
11	Greenwich	14 Ceti	E	+0.63	+0.53	−0.67	−0.48	+0.82	+0.50	−0.17	+0.14	−0.42	−1.5	−1.4
Sept. 6	Cape	ψ¹ Aquarii	IB	−1.10	−0.64	+0.05	+0.07	−0.09	−0.26	+0.42	−0.04	0.00	−2.6	−2.3
7	Santiago	10 Ceti	E	+0.73	+0.51	−0.62	−0.45	−0.76	+0.50	−0.20	+0.09	−0.16	−3.4	−3.3
11	Cape	33 Tauri	E	+0.68	+0.59	+0.74	−0.26	−0.78	−0.08	−0.22	−0.72	−0.57	−1.9	−1.8
12	Greenwich	κ Tauri	E	+1.05	+0.83	+0.13	−0.09	−0.16	+0.15	−0.19	−0.08	−0.96	−0.7	−0.5
15	Greenwich	4 Cancri	E	+0.97	+0.30	+0.06	−0.24	−0.25	+0.15	+0.16	−0.17	−0.88	+0.3	+0.5
Oct. 3	Greenwich	τ Aquarii	I	−0.99	−0.50	−0.19	−0.37	+0.42	−0.02	+0.42	−0.22	−0.48	−1.1	−0.8
3	Hamburg	τ Aquarii	I	−0.97	−0.53	−0.21	−0.40	+0.45	0.00	+0.08	−0.24	−0.51	−2.9	−2.6
3	Prague	τ Aquarii	I	−0.92	−0.45	−0.25	−0.48	+0.54	+0.04	+0.41	−0.28	−0.76	−1.7	−1.4
4	Santiago	27 Piscium	I	−1.12	−0.77	+0.08	+0.08	−0.11	−0.29	+0.44	−0.03	−0.33	−1.1	−0.8
31	Göttingen	ψ³ Aquarii	I	−0.43	−0.25	+0.56	+0.73	−0.92	−0.48	+0.08	+0.18	−0.29	+1.6	+1.7
Nov. 30	Greenwich	122 G. Pisc. (1st)	I	−0.50	−0.41	−0.88	−0.20	+0.90	+0.29	+0.30	+0.33	−0.30	−0.7	−0.5
30	Greenwich	122 G. Pisc. (2d)	I	−0.50	−0.41	−0.88	−0.20	+0.90	+0.29	+0.30	+0.33	−0.30	−4.5	−4.3
Dec. 12	Cape	46 Virginis	E	+0.88	−0.76	−0.20	−0.08	−0.22	+0.12	+0.42	+0.11	−0.92	+0.1	+0.1
25	Greenwich	351 B. Aquarii	I	−0.98	−0.57	−0.20	−0.20	+0.28	−0.01	+0.47	−0.11	−0.95	−0.5	−0.1
1893, Feb. 26	Greenwich	c Geminor.	I	−0.68	−0.40	−0.13	+0.75	+0.76	−0.21	−0.09	+0.69	−0.49	−0.9	−0.6
Mar. 25	Cape	ι Geminor.	I	−1.00	−0.69	−0.06	+0.27	+0.28	−0.19	−0.12	+0.22	−0.94	+0.5	+1.0
Apr. 18	Greenwich	32 Tauri	I	−0.85	−0.75	−0.59	+0.37	+0.69	−0.01	+0.24	+0.54	−0.41	−2.4	−2.0
21	Greenwich	47 Geminor.	I	−0.92	−0.68	−0.12	+0.48	+0.50	−0.20	−0.08	+0.46	−0.81	−1.1	−0.6
22	Greenwich	λ Cancri	I	−0.98	−0.56	+0.01	+0.32	+0.32	−0.21	−0.21	+0.25	−0.95	−0.3	+0.2
23	Cape	79 Cancri	I	−0.95	−0.41	+0.09	+0.34	+0.35	−0.23	−0.27	+0.23	−0.92	−0.9	−0.4
May 6	Greenwich	b Sagittarii	E	+0.67	−0.39	+0.03	−0.69	+0.69	+0.14	−0.22	−0.58	−0.71	−2.4	−2.5
8	Cape	ε Capricor.	E	+0.85	−0.12	−0.16	−0.44	+0.47	+0.23	−0.27	−0.29	−0.86	−0.3	−0.4
June 24	Cape	28 G. Libræ	I	−0.97	+0.77	+0.45	−0.15	+0.47	−0.19	−0.29	−0.37	−0.69	−1.2	−0.7
July 1	Cape	χ Capricor.	E	+0.94	−0.37	+0.03	+0.11	−0.12	+0.04	−0.31	+0.15	−0.59	+0.4	+0.2
6	Hamburg	e Piscium	E	+0.71	+0.48	+0.73	+0.10	−0.73	−0.23	−0.38	−0.16	−0.69	+0.6	+0.5
6	Cape	ζ Piscium	E	+0.98	+0.64	−0.34	−0.04	+0.34	+0.27	−0.34	+0.11	−0.93	−2.1	−2.3
9	Greenwich	32 Tauri	E	+1.11	+0.99	−0.07	+0.05	+0.09	+0.25	−0.28	+0.12	−0.71	−1.7	−1.9
30	Greenwich	56 Aquarii	E	+0.97	−0.09	−0.10	−0.12	+0.16	+0.16	−0.40	−0.03	−0.48	+0.9	+0.7
Aug. 2	Cape	171 B. Piscium	E	+0.88	+0.50	+0.52	+0.08	−0.52	−0.10	−0.45	−0.12	−0.78	−2.6	−2.8
21	Cape	3 Sagittarii	I	−0.88	+0.95	−0.10	+0.21	−0.23	−0.02	−0.07	+0.20	−0.86	−1.7	−1.2
Sept. 3	Cape	β Tauri	IB	−0.29	−0.28	+0.50	−0.82	−0.96	−0.16	+0.03	−0.97	+0.28	−1.8	−1.6

GROUP XIII—1891-1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	σ_0	δ_0	s	P	n	n'
													″	″
1893, Sept. 23	Cape	70 Aquarii	I	-0.92	+0.08	+0.30	+0.27	-0.40	-0.29	+0.35	+0.14	-0.30	-5.0	-4.4
Oct. 19	Greenwich	37 Capricor.	I	-0.95	+0.47	0.00	0.00	0.00	-0.07	+0.36	-0.04	-0.90	-2.2	-1.6
19	Greenwich	38 Capricor.	I	-0.73	+0.36	-0.31	-0.56	+0.64	+0.16	+0.32	-0.47	-0.69	-3.0	-2.6
20	Cape	50 Aquarii	I	-0.97	+0.25	+0.12	+0.13	-0.17	-0.18	+0.39	-0.08	-0.75	-2.0	-1.3
26	Cape	23 Tauri	E	+0.58	+0.47	-0.66	+0.55	+0.86	+0.37	-0.11	+0.73	-0.21	+2.4	+2.2
26	Cape	20 Tauri	E	+0.81	+0.66	+0.53	-0.44	-0.69	0.00	-0.25	-0.58	-0.29	-1.5	-1.7
30	Greenwich	4 Cancri	E	+0.65	+0.53	+0.10	+0.79	+0.80	-0.03	+0.14	+0.74	-0.57	-0.5	-0.7
Nov. 19	Cape	44 Piscium	I	-0.97	-0.25	+0.97	+0.22	-1.00	-0.01	+0.50	+0.14	-0.70	-0.1	+0.6
22	Greenwich	δ Arietis	I	-0.49	-0.36	-0.77	+0.48	+0.90	+0.19	+0.20	+0.66	-0.07	-1.4	-1.0
24	Cape	β Tauri	IB	-1.10	-0.95	-0.13	+0.26	+0.29	-0.24	+0.11	+0.27	+0.27	+0.9	+1.7
24	Cape	β Tauri	E	+1.12	+0.96	-0.10	+0.22	+0.24	+0.30	-0.10	+0.25	-0.27	+1.2	+0.8
Dec. 13	Pola	χ Capricor.	I	-0.83	+0.48	+0.23	+0.34	-0.41	-0.17	+0.31	+0.30	-0.82	-0.1	+0.5
20	Cape	9 Tauri	I	-0.77	-0.59	-0.56	+0.47	+0.73	+0.03	+0.25	+0.59	-0.35	+0.9	+1.4
20	Cape	17 Tauri	I	-1.13	+0.25	-0.06	+0.06	+0.09	-0.24	+0.30	+0.07	-0.51	-0.3	+0.5
20	Cape	16 Tauri	I	-0.93	-0.72	+0.42	-0.38	-0.56	-0.36	+0.22	-0.41	-0.42	-1.1	-0.4
20	Cape	20 Tauri	I	-0.84	-0.64	+0.49	-0.46	-0.67	-0.37	+0.19	-0.51	-0.38	-0.5	+0.2
1894, Jan. 12	Hamburg	24 Piscium	I	-0.79	-0.02	-0.54	-0.18	+0.57	+0.20	+0.45	-0.07	-0.78	-4.2	-3.6
12	Greenwich	24 Piscium	I	-0.84	-0.02	-0.48	-0.16	+0.50	+0.16	+0.46	-0.06	-0.81	+0.4	+1.1
16	Pola	ζ Arietis	I	-0.91	-0.68	+0.44	-0.33	-0.55	-0.35	+0.24	-0.40	-0.71	+1.1	+1.8
16	Padua	ζ Arietis	I	-0.87	-0.66	+0.48	-0.36	-0.60	-0.13	+0.23	-0.47	-0.70	+0.1	+0.8
16	Padua	τ Arietis	I	-0.88	-0.67	-0.45	+0.35	+0.57	+0.01	+0.29	+0.43	-0.71	-1.1	-0.4
18	Cape	β Tauri	I	-1.09	-0.95	-0.11	+0.26	+0.29	-0.23	+0.10	+0.27	-0.54	+1.1	+2.0
20	Greenwich	c Geminor.	I	-0.78	+0.65	+0.10	+0.73	+0.74	+0.07	+0.12	+0.71	+0.11	-4.3	-3.7
Feb. 13	Greenwich	36 Tauri	I	-0.65	-0.54	-0.48	+0.61	+0.79	+0.06	+0.17	+0.70	-0.58	-2.9	-2.4
15	Santiago	κ Aurigæ	I	-0.96	-0.87	+0.10	-0.49	-0.50	-0.19	0.00	-0.51	-0.68	+0.7	+1.5
16	Santiago	ι Geminor.	I	-0.71	-0.61	+0.07	+0.77	+0.77	-0.25	-0.08	+0.72	-0.40	+1.4	+2.0
16	Santiago	b^2 Geminor.	I	-0.84	-0.74	-0.07	-0.66	-0.66	-0.08	-0.13	-0.61	-0.49	+1.3	+2.0
26	Santiago	σ Scorpii	IB	-0.40	+0.37	+0.54	-0.72	+0.90	-0.19	-0.07	-0.83	+0.44	-0.6	-0.3
26	Santiago	σ Scorpii	E	+0.69	-0.64	+0.38	-0.52	+0.65	-0.12	+0.19	-0.57	-0.76	+1.3	+1.0
28	Cape	10 G. Sagittarii	E	+0.77	-0.84	-0.13	+0.50	-0.51	+0.04	+0.03	+0.53	-0.82	-0.5	-0.9
Mar. 14	Göttingen	136 Tauri	I	-0.38	-0.35	-0.22	+0.91	+0.94	-0.04	+0.01	+0.94	-0.36	-0.4	0.0
16	Kasan	c Geminor.	I	-0.36	-0.33	+0.17	+0.93	+0.94	-0.22	-0.05	+0.87	-0.30	-1.2	-0.9
16	Cape	φ Geminor.	I	-1.02	-0.91	+0.07	+0.32	+0.33	-0.26	-0.18	+0.23	-0.83	+2.4	+3.3
16	Greenwich	4 Cancri	I	-1.05	-0.93	-0.06	-0.24	-0.25	-0.15	-0.21	-0.25	-0.84	+0.4	+1.3
17	Santiago	ξ Cancri	I	-0.82	-0.65	-0.34	-0.56	-0.66	+0.04	-0.29	-0.43	-0.56	+0.7	+1.4
17	Santiago	90 H¹Cancri	I	-1.06	-0.83	-0.12	-0.19	-0.22	-0.14	-0.33	-0.06	-0.72	+3.1	+4.0
22	Pola	α Virginis	IB	-1.00	+0.09	+0.09	-0.02	+0.09	-0.17	-0.44	-0.04	+0.22	-3.9	-3.0
23	Greenwich	40 H. Virginis	E	+0.91	-0.33	-0.36	+0.16	-0.39	+0.25	+0.34	+0.22	-0.42	0.0	-0.5
25	Greenwich	2 Scorpii	E	+0.93	-0.73	+0.05	-0.06	+0.08	+0.04	+0.27	-0.07	-0.80	0.0	-0.5
25	Greenwich	3 Scorpii	E	+0.79	-0.61	-0.35	+0.41	-0.54	+0.19	+0.21	+0.48	+0.47	-0.7	-1.1
31	Cape	χ Capricor.	E	+0.53	-0.47	-0.42	-0.70	+0.82	+0.28	-0.14	-0.61	-0.47	+0.1	-0.2
Apr. 9	Greenwich	χ Tauri	I	-1.06	-0.84	+0.10	-0.15	-0.18	-0.23	+0.21	-0.18	-0.76	-0.2	+0.8
9	Hamburg	χ. Tauri	I	-0.98	-0.78	+0.23	-0.35	-0.42	-0.27	+0.20	-0.40	-0.71	+1.1	+2.1
10	Greenwich	107 B Aurigæ	I	-1.08	-0.95	-0.03	+0.11	+0.11	-0.20	+0.07	+0.11	-0.90	-0.8	+0.2
11	Greenwich	49 Aurigæ	I	-1.04	-0.96	+0.02	-0.29	-0.29	-0.19	-0.04	-0.31	-0.94	+1.5	+2.5
11	Pola	49 Aurigæ	I	-1.03	-0.95	+0.02	-0.33	-0.33	-0.19	-0.05	-0.33	-0.93	+0.9	+1.9
11	Hamburg	49 Aurigæ	I	-0.88	-0.81	+0.03	-0.58	-0.58	-0.14	-0.04	-0.59	-0.79	+1.1	+1.9
12	Göttingen	c Geminor.	I	-1.08	-0.98	0.00	-0.02	-0.02	-0.21	-0.17	-0.01	-1.00	+1.6	+2.6
24	Cape	38 B. Sagittarii	E	+0.82	-0.88	+0.07	-0.41	+0.42	+0.03	+0.02	-0.41	-0.76	+1.0	+0.6
25	Cape	τ Sagittarii	E	+0.88	-0.97	+0.02	+0.23	-0.23	+0.02	-0.11	+0.25	-0.91	+1.8	+1.4
29	Cape	50 Aquarii	E	+0.66	-0.43	-0.56	-0.44	+0.71	+0.34	-0.23	-0.34	-0.62	+0.4	+0.1
29	Cape	182 B. Aquarii	E	+0.44	-0.28	-0.71	-0.52	+0.89	+0.40	-0.10	-0.40	-0.41	+4.1	+3.9
May 2	Cape	147 B. Piscium	E	+0.82	+0.06	-0.59	+0.02	+0.59	+0.40	-0.31	+0.14	-0.32	+0.9	+0.4
12	Greenwich	37 Leonis	I	-0.94	-0.70	-0.34	-0.28	-0.44	+0.03	-0.41	-0.22	-0.90	+0.7	+1.6
14	Kasan	β Virginis	I	-0.71	-0.31	-0.70	-0.16	-0.72	+0.25	-0.42	-0.07	-0.64	+1.5	+2.2
21	Cape	10 G. Sagittarii	E	+0.45	-0.48	-0.14	+0.86	-0.87	+0.04	0.00	+0.87	-0.22	+0.6	+0.3
30	Greenwich	ζ Piscium	E	+0.83	+0.13	-0.58	+0.11	+0.59	+0.39	-0.31	+0.19	-0.55	-0.7	-1.2
July 15	Cape	38 B. Sagittarii	I	-0.58	+0.59	+0.07	-0.76	+0.76	-0.02	+0.01	-0.77	-0.31	-2.8	-2.2
17	Padua	A Sagittarii	I	-0.83	+0.93	+0.13	+0.35	-0.37	-0.08	+0.20	+0.31	-0.02	+0.5	+1.4
Aug. 4	Cape	β Virginis	I	-0.97	-0.51	+0.43	+0.06	+0.43	-0.39	-0.37	+0.03	-0.55	-2.4	-1.3
23	Padua	28 Tauri	E	+0.88	-0.53	+0.30	-0.44	-0.53	+0.01	-0.25	-0.47	-0.84	+1.3	+0.7
23	Padua	27 Tauri	IB	-0.87	+0.54	+0.31	-0.45	-0.55	-0.27	+0.21	-0.44	+0.83	-0.2	+0.7
23	Padua	27 Tauri	E	+1.01	+0.61	+0.13	-0.19	-0.24	+0.10	-0.28	-0.20	-0.96	+0.6	-0.1
Sept. 11	Padua	χ Capricor.	I	-0.23	+0.23	+0.63	+0.74	-0.97	-0.31	+0.03	+0.73	-0.15	+0.9	+1.1
21	Cape	116 B. Aurigæ	E	+0.59	+0.47	-0.11	+0.82	+0.83	+0.15	-0.03	+0.83	-0.56	-1.3	-1.7
Oct. 7	Prague	A Sagittarii	I	-0.57	+0.62	+0.33	+0.70	-0.78	-0.17	+0.12	+0.71	-0.62	-1.5	-0.9
7	Padua	A Sagittarii	I	-0.60	+0.65	+0.31	+0.67	-0.74	-0.17	+0.12	+0.69	-0.66	-1.1	-0.4
10	Padua	50 Aquarii	I	-0.89	+0.82	+0.22	+0.12	-0.25	-0.14	+0.40	+0.11	-0.69	-1.5	-0.5
11	Berlin	B. D. − 8° 6040	I	-0.92	+0.71	+0.04	+0.01	-0.05	-0.06	+0.44	-0.01	-0.56	-3.6	-2.6
19	Berlin	B. D. +28° 1095	E	+1.10	+0.92	0.00	-0.06	-0.06	+0.23	+0.03	-0.06	-0.94	-2.1	-2.9

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	v″	i	h_0	α_0	β_0	t	P	n	n′
													″	″
1894, Oct. 19	Berlin	B. D. +28° 1097	E	+0.98	+0.82	+0.03	+0.45	+0.45	+0.18	+0.03	+0.46	−0.84	−3.6	−4.4
21	Berlin	B. D. +24° 1918	E	+1.02	+0.92	−0.20	−0.34	−0.39	+0.30	+0.22	+0.33	−0.91	−0.4	−1.2
23	Berlin	B. D. +12° 2213	E	+0.53	+0.42	−0.79	−0.39	−0.88	+0.48	+0.12	−0.40	−0.42	−0.6	−1.0
23	Berlin	B. D. +12° 2215	E	+0.74	+0.58	+0.66	+0.33	+0.74	−0.16	+0.38	−0.33	−0.58	+0.2	−0.4
Nov. 7	Berlin	70 Aquarii	I	−0.89	+0.79	+0.19	+0.07	−0.20	−0.12	+0.48	+0.06	−0.89	−1.5	−0.5
7	Berlin	B. D. −11° 5933	I	−0.88	+0.79	−0.20	−0.07	+0.22	+0.07	+0.47	−0.10	−0.88	−1.1	−0.1
7	Berlin	B. D. −11° 5932	I	−0.88	+0.79	+0.23	+0.08	−0.24	−0.07	+0.40	+0.08	−0.88	−1.9	−0.9
7	Berlin	243 B. Aquarii	I	−0.62	+0.55	−0.70	−0.25	+0.74	+0.30	+0.38	−0.25	−0.62	−2.1	−1.4
7	Padua	70 Aquarii	I	−0.91	+0.80	+0.12	+0.05	−0.13	−0.10	+0.44	+0.04	−0.89	−1.4	−0.4
9	Berlin	B. D. + 0° 34	I	−0.88	+0.33	−0.40	+0.04	+0.40	+0.12	+0.50	+0.02	−0.53	+0.9	+1.9
9	Berlin	B. D. + 1° 52	I	−0.41	+0.15	+0.91	−0.10	−0.91	−0.46	+0.10	−0.08	−0.25	−0.4	+0.1
9	Berlin	B. D. + 2° 54	I	−0.42	+0.16	−0.90	+0.10	+0.90	+0.40	+0.32	+0.08	−0.26	−1.5	−1.0
15	Berlin	B. D. +27° 880	E	+0.74	+0.54	−0.01	+0.73	+0.73	+0.15	−0.02	+0.73	−0.37	+0.4	−0.2
15	Berlin	136 Tauri	E	+0.48	+0.35	0.00	+0.90	+0.90	+0.10	−0.01	+0.90	−0.24	−0.3	−0.7
15	Berlin	B. D. +27° 914	E	+0.64	+0.47	0.00	+0.81	+0.81	+0.14	−0.01	+0.81	−0.32	+0.1	−0.4
15	Berlin	B. D. +28° 958	E	+0.85	+0.62	−0.01	−0.62	−0.62	+0.16	0.00	−0.63	−0.43	−1.5	−2.2
15	Berlin	B. D. +28° 966	E	+1.07	+0.77	0.00	−0.21	−0.21	+0.21	−0.03	−0.20	−0.54	−0.3	−1.2
15	Greenwich	136 Tauri	IB	−0.93	−0.67	−0.02	+0.52	+0.52	−0.16	+0.02	+0.52	+0.47	−2.1	−1.0
15	Greenwich	136 Tauri	E	+0.77	+0.56	−0.02	+0.71	+0.71	+0.16	−0.02	+0.70	−0.39	0.0	−0.7
16	Berlin	B. D. +27° 1270	E	+0.84	+0.69	−0.15	−0.62	−0.64	+0.23	+0.07	−0.65	−0.55	−3.0	−3.7
20	Padua	χ Leonis	E	+0.43	+0.35	−0.88	−0.24	−0.91	+0.48	+0.09	−0.60	−0.40	−0.6	−1.0
Dec. 1	Berlin	C. D. −25° 14589	I	−0.85	+0.95	+0.16	+0.27	−0.31	−0.09	+0.23	+0.26	−0.72	−1.0	0.0
2	Cape	η Capricor.	I	−0.86	+0.96	+0.20	+0.21	−0.29	−0.11	+0.30	+0.18	−0.84	−0.8	+0.2
8	Kasan	π Piscium	I	−1.00	+0.09	−0.05	+0.03	+0.06	−0.09	+0.42	+0.02	−0.71	−1.7	−0.4
8	Berlin	π Piscium	I	−0.99	+0.09	−0.03	+0.01	+0.03	−0.10	+0.44	+0.02	−0.71	−2.7	−1.4
8	Berlin	281 B. Piscium	I	−0.84	+0.08	−0.45	+0.24	+0.52	+0.13	+0.43	+0.22	−0.60	−3.7	−2.6
8	Berlin	B. D. +11° 210	I	−0.99	+0.09	−0.01	0.00	+0.01	−0.11	+0.44	+0.01	−0.71	−2.2	−0.9
10	Padua	66 Arietis	I	−0.99	−0.34	−0.20	+0.32	+0.38	−0.07	+0.28	+0.30	−0.33	+0.9	+2.2
11	Padua	χ Tauri	I	−0.76	−0.38	−0.26	+0.67	+0.72	−0.01	+0.16	−0.56	−0.24	−0.8	+0.2
11	Berlin	χ Tauri	I	−0.96	−0.49	−0.15	+0.39	+0.42	−0.09	+0.17	+0.39	−0.16	−2.6	−1.4
1895, Jan. 1	Berlin	B. D. − 8° 596	I	−0.27	+0.24	+0.91	+0.25	−0.95	−0.44	+0.04	+0.32	−0.27	+1.9	+2.2
20	Cape	α Scorpii	IB	−0.62	+0.20	+0.22	−0.72	+0.75	−0.17	−0.11	−0.64	+0.55	−2.5	−1.7
20	Cape	α Scorpii	E	+0.85	−0.28	+0.13	−0.42	+0.43	−0.01	+0.18	−0.47	−0.76	+1.8	+1.0
31	Berlin	B. D. + 6° 127	I	−0.86	+0.26	−0.43	+0.15	+0.46	+0.13	+0.47	+0.11	−0.86	+0.4	+1.5
Feb. 6	Berlin	B. D. +27° 1141	I	−1.08	−0.82	−0.02	−0.11	−0.11	−0.20	−0.07	−0.10	−0.57	−3.0	−1.6
6	Berlin	49 Aurigæ	I	−0.70	−0.53	−0.13	−0.75	−0.77	−0.09	−0.05	−0.77	−0.37	−1.7	−0.8
6	Greenwich	49 Aurigæ	I	−0.52	−0.39	−0.18	−0.86	−0.88	−0.06	−0.03	−0.88	−0.27	−0.7	0.0
6	Cape	28 Geminor.	I	−0.95	−0.71	−0.13	−0.50	−0.52	−0.17	−0.08	−0.51	−0.50	−2.4	−1.1
6	Cape	53 Aurigæ	I	−1.02	−0.76	+0.09	+0.39	+0.40	−0.26	−0.07	+0.41	−0.53	−3.4	−2.1
7	Berlin	B. D. +25° 1778	I	−0.93	−0.81	+0.26	+0.46	+0.54	−0.30	−0.17	+0.50	−0.29	−2.0	−0.7
8	Berlin	γ Cancri	I	−1.08	−0.96	+0.16	+0.18	+0.24	−0.29	−0.28	+0.21	−0.19	+0.3	+1.7
8	Kasan	γ Cancri	I	−1.08	−0.92	+0.24	+0.27	+0.36	−0.35	−0.27	+0.31	−0.19	−0.5	+0.9
13	Cape	α Virginis	E	+0.61	+0.34	+0.72	−0.39	+0.82	−0.25	+0.35	−0.35	−0.42	−1.6	−2.2
18	Cape	38 B. Sagittarii	E	+0.91	−0.60	−0.01	−0.07	+0.07	+0.05	−0.02	−0.09	−0.90	+1.0	+0.1
Mar. 3	Berlin	B. D. +25° 677	I	−1.04	−0.46	−0.04	+0.12	+0.13	−0.33	−0.23	+0.14	−0.99	+0.5	+1.9
3	Berlin	B. D. +25° 681	I	−0.79	−0.34	+0.20	−0.63	−0.66	−0.25	+0.14	−0.58	−0.75	+1.2	+2.3
3	Berlin	B. D. +25° 682	I	−0.55	−0.24	+0.24	−0.83	−0.86	−0.26	+0.08	−0.77	−0.52	+1.2	+1.9
3	Berlin	B. D. +25° 692	I	−0.71	−0.31	−0.21	+0.70	+0.73	+0.03	+0.17	+0.67	−0.68	−1.1	−0.1
3	Berlin	B. D. +25° 703	I	−0.85	−0.37	−0.15	+0.57	+0.59	−0.03	+0.18	+0.54	−0.81	−1.3	−0.1
4	Berlin	B. D. +27° 738	I	−1.03	−0.65	−0.01	+0.26	+0.26	−0.16	+0.09	+0.27	−0.91	+0.2	+1.6
4	Berlin	B. D. +27° 737	I	−0.55	−0.35	−0.04	+0.87	+0.87	−0.03	+0.06	+0.85	−0.45	−2.1	−1.3
4	Berlin	B. D. +27° 743	I	−1.06	−0.67	+0.01	−0.12	−0.12	−0.20	+0.08	−0.10	−0.94	−1.0	+0.5
4	Berlin	B. D. +27° 744	I	−1.00	−0.63	+0.01	+0.36	+0.36	−0.15	+0.09	+0.37	−0.88	+0.9	+2.3
4	Berlin	B. D. +27° 746	I	−1.06	−0.67	+0.01	+0.17	+0.17	−0.18	+0.09	+0.19	−0.94	−1.5	0.0
5	Berlin	B. D. +27° 1078	I	−0.97	−0.74	+0.07	+0.43	+0.44	−0.20	−0.05	+0.46	−0.77	−0.4	+0.9
5	Berlin	B. D. +28° 1097	I	−0.99	−0.76	−0.07	−0.39	−0.40	−0.17	+0.05	−0.40	−0.79	−0.9	+0.5
5	Berlin	B. D. +27° 1090	I	−0.96	−0.73	+0.08	+0.47	+0.48	−0.21	−0.04	+0.50	−0.77	−1.0	+0.3
5	Berlin	B. D. +27° 1117	I	−1.09	−0.83	+0.01	+0.05	+0.05	−0.22	−0.03	+0.06	−0.87	−2.0	−0.5
6	Berlin	B. D. +26° 1495	I	−0.83	−0.69	+0.24	+0.61	+0.66	−0.25	−0.11	+0.65	−0.58	−0.6	+0.5
6	Berlin	134 B. Geminor.	I	−1.09	−0.91	+0.06	+0.15	+0.16	−0.25	−0.16	+0.17	−0.76	−2.1	−0.6
6	Berlin	B. D. +26° 1514	I	−0.97	−0.81	+0.18	+0.45	+0.48	−0.27	−0.15	+0.48	−0.68	−1.1	+0.2
6	Berlin	B. D. +26° 1516	I	−1.06	−0.88	+0.10	+0.26	+0.28	−0.25	−0.14	+0.28	−0.74	+1.6	+3.0
6	Berlin	B. D. +27° 1362	I	−0.66	−0.55	−0.30	−0.74	−0.80	−0.02	−0.11	−0.77	−0.46	−1.4	−0.5
6	Berlin	B. D. +26° 1525	I	−1.01	−0.85	−0.14	−0.35	−0.38	−0.14	−0.16	−0.36	−0.71	−1.9	−0.5
6	Berlin	B. D. +26° 1528	I	−1.10	−0.92	0.00	0.00	0.00	−0.22	−0.16	+0.02	−0.77	−2.5	−1.0
6	Berlin	B. D. +26° 1531	I	+0.16	+0.14	−0.39	+0.92	+1.00	+0.15	0.00	+0.96	+0.11	+1.5	+1.3
6	Berlin	B. D. +26° 1539	I	−1.08	−0.90	−0.08	−0.18	−0.20	−0.19	−0.17	−0.17	−0.75	−1.3	+0.2
6	Berlin	B. D. +26° 1554	I	−0.95	−0.75	+0.23	+0.51	+0.57	−0.26	−0.13	+0.55	−0.63	−2.3	−1.0
6	Berlin	B. D. +26° 1563	I	−0.85	−0.71	−0.26	−0.59	−0.64	−0.07	−0.15	−0.59	−0.59	−0.4	+0.8
6	Berlin	B. D. +26° 1561	I	−0.72	−0.60	+0.30	+0.70	+0.76	−0.26	−0.10	+0.73	−0.50	−0.2	+0.8

GROUP XIII—1891–1908—Continued.

Date.		Place.	Star.	Ph.	ϵ	κ	ω	ι	b	α_0	δ_0	τ	P	n	n'
1895, Mar.	6	Berlin	B. D. + 26° 1564	I	−0.50	−0.42	+0.36	−0.82	−0.89	+0.05	−0.10	−0.84	−0.35	−0.6	+0.1
	6	Berlin	B. D. + 26° 1580	I	−1.07	−0.89	−0.10	−0.22	−0.24	−0.18	−0.18	−0.21	−0.75	1.6	0.1
	8	Berlin	B. D. + 18° 2176	I	−1.10	−0.99	+0.09	+0.07	+0.12	−0.27	−0.35	+0.10	−0.43	−2.5	1.0
	8	Berlin	B. D. + 18° 2181	I	−0.91	−0.82	−0.46	−0.34	−0.57	+0.01	−0.36	−0.37	−0.35	−2.4	−1.1
	8	Berlin	B. D. + 18° 2182	I	−0.88	−0.79	−0.49	−0.37	−0.61	+0.03	−0.34	−0.41	−0.34	−3.3	2.1
	8	Berlin	B. D. + 17° 2092	I	−0.88	−0.79	+0.49	+0.35	+0.61	−0.41	−0.26	+0.43	−0.34	−2.2	1.0
	9	Berlin	B. D. + 11° 2219	I	−1.10	−0.95	+0.02	+0.01	+0.02	−0.23	−0.44	+0.03	−0.20	−1.1	+0.4
	9	Berlin	B. D. + 11° 2222	I	−1.07	−0.92	−0.20	−0.08	−0.22	−0.12	−0.43	−0.08	−0.19	−2.0	0.5
	10	Greenwich	82 Leonis	IB	−0.89	−0.68	−0.62	−0.11	−0.63	+0.09	0.44	−0.10	−0.03	−4.1	2.9
	10	Greenwich	83 Leonis	I	−1.05	−0.80	−0.39	−0.07	−0.40	−0.05	−0.48	−0.10	−0.04	+0.1	+1.5
	10	Greenwich	τ Leonis	I	−0.96	−0.73	−0.54	−0.09	−0.35	+0.04	−0.46	−0.03	−0.03	−0.3	+1.0
	11	Berlin	B. D. − 1° 2632	E	+0.75	+0.49	−0.72	+0.10	−0.73	+0.50	+0.23	+0.04	−0.15	−0.2	−1.0
	11	Berlin	42 G. Virginis	E	+0.67	+0.44	−0.76	+0.12	−0.78	+0.50	+0.21	+0.02	−0.14	+0.5	−0.2
	12	Berlin	49 Virginis	E	+1.01	+0.51	+0.27	−0.12	+0.29	+0.03	+0.46	−0.11	−0.40	+0.2	0.8
	29	Berlin	B. D. + 20° 493	I	−0.88	−0.03	−0.26	+0.38	+0.46	+0.04	+0.32	+0.35	−0.63	−1.0	+0.2
	29	Berlin	B. D. + 20° 496	I	−0.90	−0.04	+0.24	−0.37	−0.44	−0.25	+0.28	−0.32	−0.65	+0.9	+2.1
	29	Padua	ε Arietis	I	−0.78	−0.03	+0.34	−0.51	−0.61	−0.27	+0.22	−0.44	−0.57	+1.7	+2.8
	29	Padua	ε Arietis	EB	+0.64	+0.03	+0.41	−0.63	0.76	−0.18	−0.26	−0.55	+0.48	−0.8	1.5
	30	Berlin	B. D. + 24° 595	I	−0.62	−0.10	+0.29	−0.74	−0.79	0.26	+0.13	−0.67	−0.56	+0.8	+1.6
	30	Berlin	B. D. + 24° 603	I	−0.99	−0.16	+0.05	−0.13	−0.14	0.15	+0.23	−0.11	−0.89	−1.0	+0.4
	30	Berlin	B. D. + 24° 602	I	0.66	−0.11	+0.25	−0.72	−0.76	−0.25	+0.13	−0.66	−0.61	+0.2	+1.1
	31	Berlin	B. D. + 26° 764	I	−0.81	−0.30	−0.08	+0.61	+0.62	−0.05	+0.11	+0.60	−0.76	−2.7	−1.6
	31	Berlin	B. D. + 27° 712	I	−1.04	0.38	0.00	−0.04	−0.04	−0.17	+0.12	−0.02	−0.97	−1.7	0.2
	31	Berlin	B. D. + 27° 716		1.02	0.37	−0.02	+0.17	+0.17	−0.14	+0.12	+0.18	−0.95	−1.3	+0.1
	31	Berlin	B. D. + 27° 716	I	1.03	−0.38	−0.02	+0.15	+0.15	−0.14	+0.12	+0.16	−0.96	−1.0	+0.4
Apr.	1	Berlin	B. D. + 28° 930	I	−1.08	−0.71	−0.01	−0.07	0.07	−0.20	+0.01	−0.06	−1.00	−0.9	+0.6
	1	Berlin	B. D. + 27° 895	I	−0.37	−0.24	+0.10	+0.94	+0.94	−0.06	0.00	+0.94	−0.34	+0.8	+1.3
	1	Berlin	B. D. + 28° 934	I	−0.84	−0.55	−0.07	−0.62	0.62	−0.16	0.00	−0.61	−0.78	−0.1	+1.1
	1	Berlin	B. D. + 28° 941	I	−1.07	−0.70	+0.01	+0.12	+0.12	−0.19	+0.01	+0.13	−0.99	−0.9	+0.6
	1	Berlin	B. D. + 28° 940	I	−0.84	−0.55	−0.07	0.62	0.62	−0.17	0.00	−0.62	−0.78	+0.4	+1.6
	1	Berlin	B. D. + 27° 913	I	−0.82	−0.54	+0.07	+0.63	+0.64	−0.15	+0.01	+0.65	−0.76	−1.7	0.6
	1	Berlin	B. D. + 27° 912	I	−0.63	−0.41	+0.09	+0.82	+0.82	−0.11	+0.01	+0.82	−0.58	−1.0	0.1
	1	Berlin	B. D. + 27° 915	I	−0.63	−0.41	+0.09	+0.81	+0.81	−0.11	0.00	+0.82	−0.58	−0.3	+0.6
	1	Berlin	B. D. + 27° 933	I	−0.31	−0.21	+0.12	+0.96	+0.96	−0.04	0.00	+0.96	−0.29	−0.1	+0.3
	1	Berlin	B. D. + 28° 961	I	−1.08	−0.71	−0.01	−0.10	−0.10	−0.20	0.00	+0.09	−1.00	0.0	+1.5
	1	Berlin	B. D. + 28° 966	I	1.07	−0.70	−0.02	0.16	−0.16	−0.20	0.00	−0.15	−0.99	−0.3	+1.2
	1	Berlin	B. D. + 28° 982	I	0.89	−0.62	−0.07	0.50	−0.50	−0.12	0.02	−0.48	−0.87	+1.4	+2.6
	1	Berlin	B. D. + 27° 960	I	−1.02	−0.67	+0.05	+0.34	+0.34	−0.20	0.00	+0.36	−0.94	+1.6	+3.0
	1	Berlin	B. D. + 27° 956	I	0.52	0.34	+0.12	+0.88	+0.88	−0.10	0.00	+0.89	−0.48	1.0	0.3
	1	Berlin	B. D. + 28° 989	I	−0.60	−0.40	−0.12	−0.81	−0.83	−0.11	0.00	−0.82	−0.56	+0.1	+0.9
	2	Berlin	Anon.	I	−1.05	−0.84	−0.12	−0.30	−0.32	−0.18	−0.13	−0.30	−0.93	−0.7	+0.8
	2	Berlin	B. D. + 27° 1294	I	0.95	−0.76	−0.18	−0.47	−0.51	−0.14	−0.12	−0.48	−0.84	−0.4	+0.0
	2	Berlin	B. D. + 27° 1293	I	0.81	−0.65	−0.26	−0.64	−0.69	−0.08	−0.12	−0.64	−0.73	1.0	+0.1
	2	Berlin	B. D. + 27° 1293	I	−0.77	−0.62	−0.26	−0.66	−0.71	−0.07	−0.09	−0.69	−0.69	+0.2	+1.3
	2	Berlin	B. D. + 27° 1296	I	1.09	−0.87	−0.06	−0.14	0.15	−0.20	−0.13	−0.14	−0.97	−1.[illegible]	0.0
	2	Berlin	B. D. + 27° 1292	I	0.39	−0.31	+0.33	+0.86	+0.93	−0.17	−0.04	+0.92	−0.34	+1.0	+2.4
	2	Berlin	B. D. + 27° 1295	I	−0.43	−0.34	−0.34	−0.86	−0.92	+0.01	−0.05	−0.90	−0.38	+0.2	+0.8
	3	Cape	ω¹ Cancri	I	0.29	−0.26	+0.56	+0.78	+0.96	−0.26	−0.03	+0.84	−0.27	−1.1	−0.7
	4	Berlin	B. D. + 19° 2153	I	−1.10	−0.99	+0.11	+0.09	+0.14	−0.28	−0.34	+0.13	−0.80	+0.3	+1.8
	4	Berlin	B. D. + 19° 2170	I	1.10	−0.99	−0.13	−0.10	−0.17	−0.18	−0.35	−0.11	−0.80	−1.1	+0.4
	4	Berlin	B. D. + 19° 2171	i	1.06	−0.95	−0.25	−0.20	−0.32	−0.12	−0.36	−0.22	−0.77	0.0	+1.5
	4	Berlin	B. D. + 19° 2174	I	1.09	−0.98	−0.17	−0.13	−0.21	−0.17	−0.36	0.12	−0.79	−1.8	−0.3
	7	Berlin	9 B. Virginis	I	−0.72	−0.53	+0.75	−0.07	+0.75	−0.50	−0.23	+0.07	−0.20	−0.2	+0.8
	7	Berlin	B. D. − 0° 2507	I	1.06	−0.78	+0.20	−0.03	+0.26	−0.34	−0.43	+0.06	−0.30	−0.6	+0.9
	10	Berlin	B. D. − 19° 3869	E	+1.02	+0.20	−0.03	+0.04	−0.05	+0.17	+0.36	0.00	−0.34	−3.3	4.3
	11	Berlin	C. D. − 23° 12251	E	+0.99	−0.03	−0.07	+0.12	−0.14	+0.15	+0.29	+0.06	−0.52	−2.2	3.2
	11	Berlin	C. D. − 23° 12264	E	+0.90	−0.03	+0.20	−0.37	+0.42	−0.02	+0.29	−0.38	−0.48	−3.3	−4.2
	12	Berlin	C. D. 27° 10930	E	+0.97	−0.25	0.01	+0.06	0.06	+0.08	+0.19	+0.03	−0.70	+0.4	0.6
	28	Berlin	B. D. + 27° 866	I	−0.94	−0.58	+0.05	+0.47	+0.47	−0.15	+0.02	+0.49	−0.76	−0.4	+0.9
	29	Berlin	B. D. + 27° 1213	I	1.08	−0.79	+0.04	+0.10	+0.11	−0.21	−0.09	+0.13	−0.92	−1.0	+0.5
	29	Berlin	B. D. + 27° 1212	I	−0.96	−0.70	−0.15	−0.44	−0.46	−0.14	−0.09	0.44	−0.82	0.0	+1.3
	29	Berlin	B. D. + 27° 1236	I	1.00	−0.74	−0.14	−0.36	−0.39	−0.16	−0.11	−0.36	−0.86	−0.6	+0.8
	30	Berlin	B. D. + 24° 1777	I	0.65	−0.55	+0.46	+0.66	+0.81	−0.30	+0.11	+0.76	0.59	−0.9	0.0
	30	Berlin	B. D. + 24° 1783	I	−1.00	−0.85	+0.24	+0.34	+0.42	−0.28	−0.19	+0.39	0.91	+0.4	+1.8
May	1	Berlin	γ Cancri	I	−1.00	−0.86	−0.31	−0.28	−0.42	−0.08	−0.30	−0.33	−0.90	−0.4	+1.0
	1	Berlin	B. D. + 21° 1914	I	1.11	−0.96	+0.07	+0.06	+0.09	−0.16	−0.32	+0.09	−1.00	+1.4	+3.0
	1	Berlin	B. D. + 20° 2224	I	0.99	−0.85	+0.34	+0.29	+0.45	−0.35	−0.26	+0.37	−0.89	−0.4	+1.0
	1	Berlin	B. D. + 20° 2228	I	1.07	−0.92	+0.21	+0.18	+0.28	−0.31	−0.29	+0.23	−0.96	+2.5	+4.0
	1	Berlin	B. D. + 20° 2233	I	0.97	−0.84	−0.39	−0.32	−0.50	−0.05	−0.32	−0.37	−0.87	−0.4	+1.0
	1	Berlin	B. D. + 20° 2232	I	1.00	−0.86	+0.33	+0.27	+0.43	0.33	0.28	+0.36	−0.90	−0.0	+0.8

GROUP XIII. 1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	w	ι	h,	α,	δ	ε	P	n	n'
1895, May 1	Padua	γ Caneri	I	−1.07	−0.96	−0.05	−0.04	−0.06	−0.17	−0.31	−0.03	−1.00	0.8	−0.7
1	Padua	γ Caneri	EB	+0.98	+0.87	−0.30	−0.28	−0.41	+0.29	+0.26	−0.36	+0.91	1.5	2.5
2	Berlin	B. D. +15° 2114	I	−0.97	−0.87	+0.45	+0.22	+0.50	−0.41	−0.31	+0.32	−0.83	1.7	0.3
2	Berlin	B. D. +15° 2117	I	−0.74	−0.67	−0.67	−0.33	−0.74	+0.11	−0.27	−0.43	−0.64	1.8	0.8
2	Berlin	B. D. +15° 2118	I	−1.05	−0.95	+0.27	+0.13	+0.30	−0.32	−0.37	+0.20	−0.90	+1.5	+3.0
3	Berlin	B. D. +10° 2176	I	−1.09	−0.97	−0.14	−0.03	−0.14	−0.15	−0.44	−0.04	−0.91	+0.2	+1.7
4	Greenwich	τ Leonis	I	−1.00	−0.91	+0.04	0.00	+0.04	−0.23	−0.46	+0.03	−0.81	+0.3	+1.8
5	Berlin	98 B. Virginis	I	−1.05	−0.73	−0.22	+0.06	−0.23	−0.08	−0.48	+0.05	−0.60	−1.0	+0.5
5	Berlin	42 G. Virginis	I	−1.05	−0.73	0.24	+0.06	−0.25	−0.08	−0.48	+0.05	−0.60	0.8	+0.7
5	Berlin	B. D. 3° 3264	I	−1.07	−0.74	0.12	+0.03	−0.12	−0.13	−0.47	+0.04	0.61	0.3	+1.2
5	Berlin	B. D. − 3° 3267	I	1.06	−0.73	−0.19	0.05	+0.20	0.30	−0.44	+0.04	0.61	0.1	+1.4
5	Berlin	129 B. Virginis	I	1.08	−0.75	0.00	0.00	0.00	−0.20	−0.48	+0.04	0.62	1.5	0.0
5	Berlin	B. D. − 4° 3275	I	−1.03	−0.71	−0.31	+0.00	−0.32	−0.04	−0.48	+0.06	−0.50	0.0	+1.5
5	Berlin	B. D. − 4° 3281	I	−1.05	−0.73	+0.21	−0.06	+0.22	−0.30	−0.44	+0.02	−0.60	+1.3	+2.8
6	Berlin	B. D. −10° 3624	I	−1.02	−0.61	−0.27	+0.15	−0.31	−0.04	−0.45	+0.14	−0.48	−0.1	+1.4
6	Berlin	B. D. −10° 3627	I	1.02	−0.61	+0.27	−0.14	+0.30	−0.31	0.41	−0.04	−0.48	−0.4	+1.1
6	Cape	g Virginis	I	−0.46	0.27	0.80	+0.43	−0.90	−0.31	−0.30	+0.27	−0.21	0.6	+0.1
7	Berlin	B. D. −16° 3802	I	−1.04	0.36	−0.07	+0.07	−0.10	−0.12	−0.41	+0.10	−0.20	1.3	+0.2
9	Greenwich	π Scorpii	E	+0.74	0.01	−0.21	+0.66	−0.66	+0.25	+0.15	+0.50	−0.12	−0.2	−1.0
28	Berlin	B. D. +21° 1866	I	1.08	−0.93	−0.14	0.14	−0.10	−0.17	0.30	−0.13	0.87	−0.7	−0.8
28	Berlin	B. D. +21° 1868	I	−1.06	−0.91	0.19	0.18	−0.26	−0.13	+0.30	−0.20	0.85	0.6	+0.9
29	Berlin	B. D. +16° 1975	I	−0.58	−0.52	+0.66	+0.55	+0.86	−0.42	0.13	+0.59	0.50	1.5	−0.7
30	Berlin	B. D. +11° 2217	I	−1.08	0.97	0.22	0.06	0.23	−0.16	0.44	−0.00	0.97	0.0	+1.5
30	Berlin	B. D. +11° 2221	I	−1.11	1.00	+0.06	+0.02	+0.06	−0.26	0.43	+0.05	1.00	0.2	+1.4
30	Berlin	B. D. +11° 2223	I	1.10	−0.99	+0.13	+0.03	+0.13	+0.14	−0.43	+0.10	0.99	+1.3	+2.9
30	Berlin	45 Leonis	I	−0.67	0.60	+0.79	+0.19	+0.81	0.40	0.18	+0.37	0.60	+0.2	+1.2
31	Berlin	B. D. + 5° 2467	I	−1.05	0.88	−0.31	0.31	−0.31	0.06	−0.47	0.04	0.04	−0.5	+2.0
June 9	Berlin	248 B. Sagittarii	E	+0.83	0.71	+0.21	+0.34	0.40	−0.04	−0.16	+0.47	0.46	+2.7	+1.8
12	Berlin	B. D. −15° 6103	E	+0.08	0.09	+0.93	+0.37	1.00	−0.40	0.13	+0.57	0.08	+1.2	+1.1
12	Berlin	B. D. 15° 6109	E	+0.85	−0.96	+0.26	+0.11	−0.28	−0.11	0.43	+0.15	0.88	+3.4	+2.5
12	Berlin	B. D. 15° 6111	E	+0.81	0.91	+0.39	+0.15	−0.42	−0.16	−0.43	+0.13	0.84	+2.6	+1.6
13	Berlin	B. D. 10° 5973	E	+0.89	0.97	+0.04	+0.01	−0.04	0.00	0.46	+0.02	0.98	[illegible]	+2.6
13	Berlin	B. D. 10° 5974	E	+0.77	0.83	+0.50	+0.00	−0.51	0.21	−0.43	+0.20	0.84	[illegible]	+1.4
13	Berlin	65 Aquarii	E	+0.82	0.80	−0.38	0.07	+0.30	0.18	0.37	0.15	0.90	+1.5	+0.6
15	Berlin	B. D. + 0° 2	E	+0.82	0.80	+0.39	0.10	0.40	0.18	0.46	0.01	0.90	[illegible]	+1.6
15	Berlin	B. D. + 0° 8	E	+0.43	0.42	−0.85	+0.23	+0.88	+0.42	0.12	+0.02	0.48	0.4	0.9
16	Berlin	B. D. + 6° 114	E	+0.54	0.44	+0.74	0.36	−0.82	0.34	0.35	−0.19	0.56	+2.6	+2.0
16	Berlin	B. D. + 6° 115	E	+0.90	0.74	−0.19	+0.00	+0.21	+0.13	0.43	+0.02	0.94	−1.1	+0.1
26	Hamburg	α Leonis	I	−1.03	−0.93	+0.35	+0.11	+0.37	0.37	0.36	+0.24	0.77	1.0	+0.5
26	Hamburg	α Leonis	EB	+1.07	+0.97	+0.23	+0.07	+0.25	+0.12	+0.43	+0.08	+0.77	+0.4	0.8
26	Göttingen	α Leonis	I	−1.02	−0.92	+0.37	+0.12	+0.39	0.37	0.35	+0.25	0.73	+1.3	+0.2
26	Pola	α Leonis	I	−0.99	−0.90	+0.42	+0.14	+0.44	0.38	0.34	+0.28	0.71	0.2	+1.3
26	Greenwich	α Leonis	I	−0.94	−0.85	+0.50	+0.16	+0.53	−0.41	0.31	+0.20	0.67	1.8	0.4
26	Greenwich	α Leonis	EB	+1.03	+0.93	+0.34	+0.11	+0.36	+0.06	+0.43	+0.17	+0.73	−0.4	1.8
27	Berlin	B. D. + 6° 2387	I	−0.87	−0.76	+0.62	+0.03	+0.62	0.47	0.29	+0.20	0.73	1.5	0.2
July 2	Berlin	C. D. −23° 12194	I	−0.75	−0.12	+0.28	0.61	+0.67	0.29	0.20	0.50	0.56	1.1	0.0
2	Berlin	C. D. −23° 12202	I	−0.85	0.13	+0.24	0.51	+0.56	−0.28	0.23	−0.40	0.62	1.8	0.5
2	Berlin	C. D. −23° 12208	I	−0.95	−0.15	+0.17	0.37	+0.41	−0.26	0.27	0.32	0.68	2.7	1.3
9	Padua	δ Capricor.	IB	−0.87	+0.96	+0.17	+0.07	0.18	0.07	+0.30	+0.13	+0.54	[illegible]	0.0
9	Padua	δ Capricor.	E	+0.88	−0.95	−0.22	0.09	+0.24	+0.1	0.38	0.18	0.53	+1.6	+0.6
14	Berlin	B. D. + 9° 148	E	+0.47	−0.26	−0.73	+0.40	+0.87	+0.53	0.13	+0.28	0.40	0.8	1.3
14	Berlin	B. D. + 9° 146	E	+0.89	−0.49	+0.27	−0.18	0.32	0.09	0.45	0.13	0.93	+3.8	[illegible]
14	Berlin	B. D. +10° [illegible]	E	+0.89	−0.49	+0.25	0.18	0.31	0.08	0.47	0.13	0.93	+3.8	[illegible]
15	Berlin	B. D. +15° [illegible]	E	+0.95	−0.32	−0.12	+0.13	+0.17	+0.15	0.39	0.08	0.92	[illegible]	1.7
15	Berlin	B. D. +15° 304	E	+0.87	−0.29	−0.28	+0.32	+0.42	+0.23	0.36	+0.2	0.85	+1.4	+0.4
16	Berlin	B. D. +19° 433	E	+0.84	−0.14	−0.25	+0.44	+0.50	+0.25	0.27	+0.34	0.75	+2.8	1.0
16	Berlin	47 Arietis	E	+0.73	0.12	−0.32	+0.59	+0.67	+0.20	0.22	+0.48	0.64	+1.8	1.0
16	Greenwic	47 Arietis	E	+0.85	−0.14	−0.24	+0.44	+0.50	+0.20	0.26	+0.38	0.76	+2.6	+1.7
17	Hamburg	η Tauri	E	+1.01	+0.04	0.00	0.00	0.00	+0.13	0.26	0.01	0.76	+3.0	+1.9
17	Berlin	27 Tauri	E	+0.75	+0.03	−0.19	+0.64	+0.66	+0.23	0.16	+0.55	0.57	[illegible]	+0.7
17	Berlin	28 Tauri	E	+0.93	+0.04	−0.11	+0.36	+0.38	+0.19	0.21	+0.31	0.71	[illegible]	[illegible]
17	Berlin	B. D. +24° 589	E	+0.72	+0.03	+0.18	0.68	0.70	0.07	0.21	0.61	0.55	+1.7	0.9
18	Berlin	B. D. +26° 759	E	+0.84	+0.13	0.01	+0.57	+0.57	+0.19	0.08	+0.53	0.57	+1.9	+1.0
30	Cape	48 B. Scorpii	I	−0.94	−0.15	+0.06	0.28	+0.20	0.16	0.20	0.23	0.01	0.6	+0.8
Aug. 7	Greenwich	81 Aquarii	E	+0.85	0.93	0.34	−0.01	+0.34	+0.18	0.40	0.13	0.43	[illegible]	[illegible]
7	Greenwich	82 Aquarii	IB	0.54	+0.59	+0.80	+0.02	−0.80	0.37	+0.19	+0.26	−0.28	[illegible]	[illegible]
10	Berlin	B. D. + 8° 158	E	+0.88	0.61	−0.26	+0.13	+0.30	+0.18	0.40	+0.06	0.87	[illegible]	[illegible]
10	Berlin	180 B. Piscium	E	+0.70	0.48	+0.57	0.34	0.66	0.26	0.30	[illegible]	0.69	[illegible]	[illegible]
12	Greenwich	B. D. +18° 325	E	+0.92	0.30	+0.17	0.17	0.21	−0.01	0.37	0.16	0.98	[illegible]	[illegible]
13	Berlin	B. D. +23° 462	E	+0.91	+0.02	+0.14	−0.37	−0.40	0.00	0.26	0.36	−0.87	[illegible]	1.5

GROUP XIII—1891–1908—Continued

Date.		Place.	Star.	Ph.	ι	κ	m	i	h	α	β	ι	P	n	n′
														″	″
1895, Aug.	13	Berlin	B. D. +23° 463	E	+0.96	+0.02	+0.10	−0.26	−0.28	+0.05	−0.27	−0.26	−0.92	+3.2	+2.1
	13	Berlin	B. D. +23° 465	E	+0.99	+0.02	+0.05	−0.13	−0.14	+0.08	−0.27	−0.06	−0.95	+2.3	+1.2
	13	Berlin	B. D. +23° 468	E	+0.73	+0.01	−0.24	+0.65	+0.69	+0.25	−0.17	+0.55	−0.70	+1.4	+0.6
	13	Berlin	B. D. +23° 467	E	+0.93	+0.02	+0.13	−0.36	−0.38	+0.02	−0.27	−0.29	−0.89	+2.1	+1.1
	13	Berlin	B. D. +23° 469	E	+0.97	+0.02	+0.09	−0.24	−0.26	+0.06	−0.28	−0.24	−0.93	+3.2	+2.1
	16	Berlin	B. D. +27° 1133	E	+1.06	+0.64	−0.06	−0.15	−0.16	+0.20	+0.06	−0.18	−0.62	+1.6	+0.4
Sept	2	Berlin	B. D. −15° 6119	I	−0.65	+0.71	+0.66	+0.20	−0.69	−0.30	+0.24	+0.40	−0.19	−0.1	+0.9
	2	Greenwich	ι Aquarii	I	−0.84	+0.91	−0.35	−0.09	+0.36	+0.13	+0.43	−0.18	−0.25	−1.3	0.0
	5	Berlin	B. D. + 1° 10	E	+0.83	−0.81	−0.38	+0.12	+0.30	+0.20	−0.37	−0.01	−0.35	+0.8	−0.2
	5	Berlin	B. D. + 2° 16	E	+0.87	−0.85	+0.23	−0.08	−0.24	0.00	−0.50	−0.03	−0.37	+2.1	+1.1
	6	Berlin	60 Piscium	E	+0.51	−0.44	−0.73	+0.40	+0.83	−0.11	−0.16	+0.16	−0.20	+0.3	−0.3
	6	Berlin	62 Piscium	E	+0.75	−0.65	+0.50	−0.27	−0.57	−0.23	−0.43	−0.13	−0.42	+3.4	+2.5
	6	Berlin	B. D. + 6° 111	E	+0.55	−0.48	+0.70	−0.38	−0.80	−0.34	−0.36	−0.19	−0.31	+1.8	+1.2
	6	Padua	62 Piscium	IB	−0.69	+0.60	+0.57	−0.32	−0.65	−0.32	+0.27	−0.13	+0.39	−1.7	−0.6
	6	Padua	62 Piscium	E	+0.70	−0.69	+0.44	−0.25	−0.50	−0.20	−0.46	−0.12	−0.44	+1.7	+0.8
	9	Berlin	B. D. +21° 413	E	+0.56	−0.08	−0.33	+0.76	+0.82	+0.30	−0.14	+0.63	−0.54	+0.4	−0.3
	9	Berlin	B. D. +21° 416	E	+0.82	−0.12	−0.21	+0.49	+0.53	+0.23	−0.24	+0.40	−0.80	+1.9	+0.9
	9	Berlin	B. D. +21° 427	E	+0.84	−0.12	−0.19	+0.46	+0.50	+0.22	−0.24	+0.38	−0.82	+1.4	+0.4
	9	Berlin	B. D. +22° 463	E	+0.93	−0.13	+0.11	−0.29	−0.31	+0.01	−0.30	−0.28	−0.90	+2.6	+1.5
	9	Berlin	B. D. +22° 466	E	+0.94	−0.13	+0.11	−0.26	−0.28	+0.02	−0.30	−0.25	−0.91	+2.9	+1.8
	9	Berlin	B. D. +22° 468	E	+0.76	−0.11	+0.23	−0.57	−0.61	−0.10	−0.24	−0.50	−0.74	+2.9	+2.0
	9	Berlin	B. D. +22° 469	E	+0.98	−0.14	−0.03	+0.07	+0.07	+0.12	−0.30	+0.02	−0.95	+3.1	+2.0
	10	Berlin	B. D. +24° 613	E	+0.94	+0.08	+0.07	−0.36	−0.37	+0.05	−0.21	−0.36	−0.92	+1.7	+0.6
	10	Berlin	B. D. +25° 667	E	+0.95	+0.08	+0.06	−0.33	−0.34	+0.06	−0.21	−0.32	−0.93	+2.6	+1.5
	10	Berlin	B. D. +24° 616	E	+1.01	+0.09	−0.02	+0.09	+0.09	+0.15	−0.20	+0.06	−0.99	+3.8	+2.6
	10	Berlin	B. D. +25° 671	E	+0.97	+0.09	+0.05	−0.26	−0.27	+0.07	−0.21	−0.27	−0.95	+2.2	+1.0
	10	Berlin	B. D. +24° 617	E	+0.82	+0.07	−0.10	+0.56	+0.57	+0.22	−0.18	+0.51	−0.80	+2.0	+1.0
	10	Berlin	B. D. +25° 677	E	+0.51	+0.04	+0.15	−0.85	−0.87	0.09	−0.12	−0.80	−0.50	+2.4	+1.8
	10	Berlin	B. D. +25° 678	E	+0.54	+0.05	+0.13	−0.84	−0.86	0.09	−0.14	−0.78	−0.52	+2.5	+1.9
	10	Berlin	B. D. +25° 681	E	+0.98	+0.09	+0.03	−0.22	−0.22	+0.08	−0.21	−0.23	−0.96	+2.4	+1.2
	10	Berlin	B. D. +25° 682	E	+0.98	+0.09	+0.04	−0.25	−0.26	+0.09	−0.20	−0.26	−0.96	+2.8	+1.6
	10	Berlin	B. D. +25° 685	E	+0.88	+0.08	+0.07	−0.49	−0.50	+0.03	−0.18	−0.46	−0.86	+2.4	+1.3
	11	Berlin	B. D. +27° 733	E	+0.99	+0.30	+0.03	+0.28	+0.28	+0.17	−0.08	+0.25	−0.95	−1.4	+0.2
	11	Berlin	B. D. +27° 738	E	+0.99	+0.30	+0.03	+0.28	+0.28	+0.17	−0.09	+0.25	−0.95	+0.4	−0.8
	15	Greenwich	83 Cancri	E	+1.11	+0.92	+0.15	+0.08	+0.17	+0.18	+0.38	+0.08	−0.57	+2.7	+1.4
	29	Hamburg	δ Capricor.	I	−0.90	+0.93	+0.08	+0.03	−0.09	−0.06	+0.39	+0.08	−0.75	−1.4	0.0
	29	Prague	δ Capricor.	I	−0.89	+0.92	−0.11	−0.04	+0.11	+0.06	+0.42	−0.02	−0.74	−2.3	−0.9
	29	Greenwich	δ Capricor.	I	−0.87	+0.90	+0.24	+0.09	−0.26	−0.12	+0.3	+0.18	−0.73	−1.5	−0.1
	29	Greenwich	δ Capricor.	EB	+0.90	−0.93	−0.09	−0.03	+0.09	+0.06	−0.40	−0.08	+0.75	+0.1	−1.0
	29	Berlin	B. D. −17° 6363	I	−0.89	+0.92	−0.16	−0.06	+0.17	+0.04	+0.43	−0.09	−0.74	−3.1	−1.7
	29	Berlin	δ Capricor.	I	−0.90	+0.93	−0.02	−0.01	+0.02	+0.02	+0.45	0.00	−0.75	−4.0	−2.6
	29	Berlin	B. D. −16° 5946	I	−0.84	+0.86	−0.35	−0.11	+0.37	+0.12	+0.41	−0.21	−0.70	−3.3	−2.0
	29	Berlin	δ Capricor.	EB	+0.84	−0.86	−0.34	−0.12	+0.36	+0.17	−0.43	−0.23	+0.70	+2.3	+1.3
	30	Berlin	B. D. −11° 5842	I	−0.87	+0.97	−0.17	−0.02	+0.17	+0.08	+0.46	−0.08	−0.60	−2.9	−1.5
	30	Berlin	58 Aquarii	I	−0.87	+0.97	−0.17	−0.02	+0.17	+0.08	+0.47	−0.08	−0.60	−3.2	−1.8
	30	Greenwich	58 Aquarii	I	−0.89	+0.98	+0.12	+0.01	−0.12	−0.07	+0.43	+0.08	−0.60	−2.7	−1.3
Oct	1	Berlin	282 B. Aquarii	I	−0.88	+0.98	+0.17	+0.02	−0.17	−0.09	+0.51	+0.07	−0.37	−2.5	−1.1
	1	Berlin	B. D. − 5° 5963	I	−0.83	+0.92	+0.37	+0.03	−0.37	−0.18	+0.49	+0.10	−0.34	−1.5	−0.2
	4	Berlin	235 B. Piscium	E	+0.74	−0.52	+0.46	−0.38	−0.60	−0.22	−0.40	−0.22	−0.22	+2.4	+1.5
	4	Berlin	B. D. +11° 175	E	+0.81	−0.57	+0.36	−0.32	−0.48	−0.17	−0.42	−0.20	−0.24	+2.5	+1.5
	7	Berlin	η Tauri	E	+0.46	−0.02	−0.20	+0.86	+0.89	+0.24	−0.08	+0.74	−0.36	−0.5	−1.1
	7	Berlin	24 Tauri	E	+0.57	−0.03	−0.18	+0.80	+0.82	+0.24	−0.11	+0.68	−0.46	+0.4	−0.3
	7	Berlin	B. D. +23° 531	E	+0.64	−0.03	−0.17	+0.74	+0.76	+0.23	−0.13	+0.64	−0.51	−0.2	−1.0
	7	Berlin	B. D. +23° 540	E	+0.95	−0.05	−0.06	+0.26	+0.27	+0.17	−0.23	+0.22	−0.76	+0.6	−0.5
	7	Berlin	B. D. +23° 549	E	+0.91	−0.05	−0.08	+0.38	+0.39	+0.18	−0.22	+0.31	−0.73	+1.3	+0.2
	7	Berlin	10[illegible] B. Tauri	E	+0.92	−0.05	−0.08	+0.36	+0.37	+0.19	−0.23	+0.31	−0.73	+1.5	+0.4
	7	Berlin	B. D. +23° 560	E	+0.89	−0.04	−0.09	+0.43	+0.44	+0.19	−0.22	+0.36	−0.71	+0.9	−0.1
	7	Berlin	B. D. +23° 561	E	+0.85	−0.04	−0.11	+0.50	+0.51	+0.20	−0.21	+0.42	−0.68	+1.3	+0.3
	7	Berlin	B. D. +23° 567	E	+0.60	−0.03	−0.16	+0.77	+0.79	+0.23	−0.12	+0.67	−0.48	−0.2	−0.9
	7	Berlin	B. D. +24° 578	E	+0.87	−0.04	−0.09	+0.45	+0.46	+0.19	−0.22	+0.36	−0.70	+0.6	−0.4
	7	Berlin	B. D. +24° 595	E	+0.97	−0.05	+0.04	−0.20	−0.20	+0.05	−0.24	−0.20	−0.77	−2.2	−3.4
	7	Berlin	B. D. +24° 598	E	+0.96	−0.05	+0.04	−0.22	−0.22	+0.02	−0.23	−0.22	−0.77	+2.6	+1.4
	9	Berlin	406 B. Tauri	E	+1.05	+0.42	0.00	0.00	0.00	+0.17	+0.01	−0.03	−0.97	−2.5	−3.8
	10	Berlin	B. D. +27° 1230	E	+0.97	+0.56	+0.19	+0.36	+0.41	+0.12	+0.10	+0.37	−0.91	−0.9	−2.1
	11	Berlin	B. D. +24° 1785	E	+0.23	+0.17	+0.67	+0.72	+0.98	−0.16	+0.08	+0.90	−0.20	0.0	−0.3
	11	Berlin	B. D. +24° 1783	E	+1.05	+0.76	−0.18	−0.20	−0.27	+0.26	+0.21	−0.28	−0.93	+0.1	−1.2
	11	Berlin	B. D. +24° 1800	E	+0.96	+0.70	+0.33	+0.35	+0.47	+0.07	+0.23	−0.40	−0.85	+1.0	−0.2
	28	Berlin	B. D. − 8° 5980	I	−0.90	+1.00	0.00	0.00	0.00	−0.03	+0.47	+0.01	−0.79	−3.7	−2.2
	28	Berlin	82 Aquarii	I	−0.90	+1.00	−0.07	0.00	+0.07	+0.01	+0.47	+0.01	−0.79	−3.2	−1.7
	29	Berlin	B. D. − 2° 6007	I	−0.67	+0.73	−0.65	+0.15	+0.67	+0.30	+0.43	−0.07	−0.48	−4.8	−3.7

GROUP XIII—1891-1908—Continued.

Date.		Place.	Star.	Ph.	z	x	w	i	h	a	δ	t	P	n	n'
														″	″
1895, Oct.	29	Berlin	B. D. − 2° 6013	I	−0.88	+0.96	+0.12	−0.03	−0.12	−0.06	+0.46	+0.03	−0.63	−2.7	−1.3
	31	Berlin	B. D. + 8° 158	I	−0.88	+0.76	−0.20	+0.14	+0.24	+0.06	+0.47	+0.08	−0.28	−2.7	−1.3
	31	Berlin	180 B. Piscium	I	−0.65	+0.55	+0.57	−0.40	−0.70	−0.34	+0.25	−0.17	−0.21	−2.2	−1.1
	31	Berlin	B. D. + 8° 177	I	−0.33	+0.28	−0.74	+0.56	+0.93	+0.40	+0.26	+0.29	−0.10	−3.3	−2.8
	31	Berlin	210 B. Piscium	I	−0.80	+0.69	−0.38	+0.29	+0.48	+0.18	+0.43	+0.17	−0.26	−0.7	+0.6
Nov	1	Berlin	B. D. +15° 290	I	−0.94	+0.56	−0.03	+0.02	+0.05	−0.04	+0.42	+0.06	−0.02	−3.7	−2.2
	3	Greenwich	19 Tauri	E	+0.95	−0.20	−0.04	+0.22	+0.22	+0.14	−0.23	+0.16	−0.33	−0.4	−1.6
	3	Greenwich	20 Tauri	E	+0.67	−0.14	−0.14	+0.72	+0.73	+0.22	−0.14	+0.60	+0.59	−1.1	−1.9
	10	Pola	ρ Leonis	IB	−1.08	−0.99	0.00	0.00	0.00	−0.21	−0.43	+0.09	+0.95	−0.4	+1.3
	10	Pola	ρ Leonis	E	+1.05	+0.96	−0.25	−0.02	−0.25	+0.31	+0.40	−0.15	−0.92	−0.7	−2.0
	10	Berlin	B. D. +10° 2147	E	+1.11	+0.99	−0.04	0.00	−0.04	+0.15	−0.27	−0.05	−0.95	+1.4	+0.1
	10	Berlin	45 Leonis	E	+1.02	+0.91	−0.40	+0.04	−0.40	+0.04	−0.28	−0.21	−0.87	+0.8	−0.5
	25	Berlin	B. D. − 3° 5638	I	−0.72	+0.80	+0.56	−0.10	−0.57	−0.28	+0.32	+0.14	−0.75	−1.2	0.0
	27	Göttingen	62 Piscium	I	−0.83	+0.82	−0.34	+0.23	+0.41	+0.16	+0.46	+0.10	−0.71	−0.1	+1.2
	27	Göttingen	δ Piscium	I	−0.88	+0.86	+0.24	−0.16	−0.29	−0.17	+0.41	−0.04	−0.75	−2.0	−0.5
	27	Pola	δ Piscium	I	−0.92	+0.90	+0.04	−0.02	−0.04	−0.06	+0.45	+0.01	−0.78	−2.9	−1.4
	28	Berlin	B. D. +13° 250	I	−0.71	+0.51	+0.45	−0.46	−0.64	−0.30	+0.27	−0.25	−0.41	−2.3	−1.1
	28	Berlin	B. D. +13° 267	I	−0.93	+0.67	+0.06	−0.07	−0.09	−0.09	+0.40	0.00	−0.54	−3.2	−1.6
	29	Berlin	B. D. +18° 319	I	−0.86	+0.42	+0.21	−0.36	−0.42	−0.21	+0.32	−0.23	−0.30	−1.6	−0.2
	30	Berlin	B. D. +21° 416	I	−0.96	+0.32	−0.01	+0.04	+0.04	−0.06	+0.31	+0.06	+0.03	−3.9	−2.3
	30	Berlin	B. D. +21 427	I	−0.96	+0.32	+0.01	−0.03	−0.03	−0.08	+0.30	0.00	+0.03	−4.0	−2.4
	30	Berlin	B. D. +22° 466	I	−0.58	+0.19	+0.25	−0.76	−0.80	−0.27	+0.16	−0.61	+0.02	−6.1	−5.1
	30	Berlin	B. D. +22° 469	I	−0.83	+0.28	+0.16	−0.48	−0.51	−0.21	+0.24	−0.36	+0.03	−2.2	−0.8
Dec	6	Berlin	80 Cancri	E	+0.64	+0.52	−0.75	−0.33	−0.82	+0.41	+0.15	−0.61	−0.56	+0.6	−0.2
	10	Greenwich	ψ Virginis	E	+0.36	+0.32	−0.75	+0.56	−0.94	+0.49	+0.05	+0.23	−0.31	+0.4	−0.1
	28	Padua	20 Tauri	I	−0.76	+0.24	−0.10	+0.63	+0.63	+0.07	+0.21	+0.56	−0.45	−4.0	−2.7
	29	Berlin	B. D. +26° 750	I	−0.92	0.00	+0.03	+0.38	+0.38	−0.06	+0.12	+0.39	−0.27	−1.9	−0.4
	29	Berlin	B. D. +26° 752	I	−0.95	0.00	+0.04	+0.32	+0.32	−0.08	+0.11	+0.35	−0.28	−2.0	−0.4
	29	Berlin	B. D. +26° 764	I	−0.98	0.00	+0.03	+0.19	+0.19	−0.09	+0.11	+0.21	−0.28	−5.0	−3.3
	29	Berlin	B. D. +27° 716	I	−0.95	0.00	−0.04	−0.31	−0.31	−0.14	+0.09	−0.26	−0.28	−4.4	−2.8
1896, Jan.	7	Cape	ι Virginis	E	+1.06	+0.86	+0.17	−0.19	+0.26	+0.11	+0.45	−0.13	−0.97	−0.1	−1.5
	8	Berlin	B. D. −19° 3870	E	+0.84	+0.64	−0.31	+0.56	−0.04	+0.39	+0.24	+0.36	−0.75	+0.4	−0.7
	8	Berlin	B. D. −19° 3869	E	+0.92	+0.70	+0.25	−0.47	+0.53	−0.01	+0.35	−0.37	−0.82	+0.6	−0.6
	8	Berlin	B. D. −19° 3879	E	+0.74	+0.56	−0.35	+0.64	−0.73	+0.40	+0.20	+0.42	−0.67	−0.4	−1.4
	19	Padua	14 Piscium	I	−0.68	+0.76	+0.62	−0.19	−0.65	−0.32	+0.27	+0.16	−0.61	+0.1	+1.3
	21	Berlin	B. D. + 8° 153	I	−0.37	+0.35	−0.71	+0.57	+0.91	+0.40	+0.28	+0.25	+0.41	−3.8	−3.2
	21	Berlin	B. D. + 9° 116	I	−0.89	+0.84	+0.17	−0.14	−0.22	−0.13	+0.41	−0.02	−0.98	−3.1	−1.6
	22	Santiago	ι Arietis	I	−0.49	+0.40	+0.46	−0.71	−0.85	−0.34	+0.15	−0.53	−0.55	+1.1	+1.9
	24	Berlin	B. D. +22° 473	I	−0.89	+0.32	−0.09	+0.35	+0.36	+0.03	+0.28	+0.32	−0.81	−2.8	−1.3
	24	Berlin	B. D. +22° 475	I	−0.96	+0.34	−0.01	+0.02	+0.02	−0.07	+0.29	+0.05	−0.87	−5.0	−3.4
	24	Berlin	B. D. +22° 475	I	−0.96	+0.34	+0.01	+0.02	−0.02	−0.08	+0.29	+0.01	−0.87	−5.8	−4.2
	24	Berlin	B. D. +22° 480	I	−0.52	+0.18	−0.20	+0.81	+0.84	+0.18	+0.18	+0.69	−0.47	−3.1	−2.2
	24	Berlin	B. D. +22° 482	I	−0.67	+0.24	−0.17	+0.69	+0.71	+0.13	+0.21	+0.69	−0.61	−3.6	−2.5
	24	Berlin	B. D. +23° 454	I	−0.92	+0.33	+0.06	−0.25	−0.26	−0.14	+0.27	−0.17	−0.84	−5.0	−3.4
	24	Berlin	B. D. +23° 457	I	−0.36	+0.13	−0.20	+0.01	+0.03	+0.20	+0.10	+0.77	−0.32	−0.8	−0.2
	24	Berlin	B. D. +23° 460	I	−0.59	+0.21	−0.16	+0.77	+0.70	+0.14	+0.18	+0.67	−0.53	−3.5	−2.5
	24	Berlin	B. D. +23° 470	I	−0.56	+0.20	+0.16	−0.80	[illegible]	−0.25	+0.16	−0.80	−0.50	−0.6	+0.4
	26	Berlin	B. D. +27° 771	I	−0.73	−0.12	+0.17	+0.67	[illegible]	−0.06	+0.05	+0.71	−0.40	−2.8	−1.6
	26	Berlin	B. D. +27° 778	I	−0.96	−0.15	−0.09	−0.33	−0.34	−0.14	+0.03	−0.30	−0.53	−4.2	−2.6
	26	Berlin	B. D. +27° 783	I	−1.00	−0.16	−0.06	−0.20	−0.21	−0.15	+0.03	−0.17	−0.55	−4.7	−3.0
	26	Santiago	116 B. Aurigæ	I	−0.96	−0.09	−0.12	−0.35	−0.37	−0.15	+0.02	−0.34	−0.52	−1.4	+0.2
	27	Santiago	25 Geminor.	I	−0.91	−0.28	+0.28	+0.44	[illegible]	−0.21	+0.08	+0.54	−0.32	−1.3	+0.3
	27	Berlin	B. D. +27° 1066	I	−0.97	−0.31	+0.17	+0.33	+0.32	−0.17	−0.35	+0.40	−0.38	−4.3	−2.6
	27	Berlin	B. D. +27° 1089	I	−1.03	−0.33	+0.06	+0.11	[illegible]	−0.15	+0.07	+0.15	−0.40	−4.3	−2.5
	27	Berlin	B. D. +27° 1090	I	−0.41	−0.13	−0.43	[illegible]	[illegible]	−0.01	[illegible]	−0.01	−0.16	−2.7	−2.0
	28	Berlin	B. D. +25° 1644	I	−0.85	−0.43	−0.39	−0.36	[illegible]	−0.04	−0.16	−0.54	−0.16	−3.4	−1.9
	28	Berlin	B. D. +25° 1659	I	−1.03	−0.52	−0.17	−0.19	[illegible]	−0.14	−0.16	−0.20	−0.19	−4.9	−3.1
	28	Berlin	B. D. +25° 1709	I	−0.89	−0.45	−0.37	−0.38	−0.53	−0.06	−0.20	−0.46	[illegible]	−3.5	−2.0
	31	Cape	ρ Leonis	E	+0.98	+0.85	+0.45	0.00	+0.45	0.00	+0.45	+0.15	−0.40	+2.7	+1.4
Feb.	19	Berlin	B. D. +17° 339	I	−0.91	+0.63	+0.10	−0.18	−0.21	−0.12	+0.36	−0.08	−0.90	−1.8	−0.2
	19	Berlin	B. D. +17° 346	I	−0.89	+0.61	−0.14	+0.27	+0.30	+0.06	+0.35	+0.23	−0.94	−0.9	+0.7
	20	Berlin	B. D. +21° 403	I	−0.27	+0.13	+0.30	−0.09	−0.07	−0.31	+0.04	−0.09	−0.28	−0.3	+0.2
	20	Berlin	B. D. +22° 438	I	−0.92	+0.45	+0.06	−0.21	−0.22	−0.12	+0.29	−0.14	−0.07	−2.9	−1.3
	20	Berlin	B. D. +22° 441	I	−0.85	+0.41	+0.12	−0.45	−0.46	−0.19	+0.25	−0.31	−0.89	−0.9	+0.6
	20	Berlin	B. D. +22° 446	I	−0.94	+0.46	−0.03	+0.13	+0.13	−0.05	+0.31	+0.14	−0.90	−2.9	−1.2
	20	Berlin	B. D. +22° 453	I	−0.82	+0.40	+0.12	−0.49	−0.51	−0.20	+0.24	−0.37	−0.86	−1.3	+0.2
	20	Berlin	B. D. +22° 455	I	−0.95	+0.46	−0.01	+0.03	+0.03	−0.06	+0.30	+0.06	−1.00	−3.3	−1.6
	20	Berlin	B. D. +22° 457	I	−0.82	+0.40	+0.12	−0.48	−0.50	−0.20	+0.21	−0.36	−0.86	[illegible]	+0.9
	21	Berlin	B. D. +24° 598	I	−0.70	+0.18	−0.03	+0.69	+0.69	+0.07	+0.17	+0.04	−0.71	−2.7	−1.4
	21	Berlin	B. D. +25° 656	I	−0.70	+0.18	+0.03	−0.71	−0.71	−0.20	+0.12	−0.60	−0.71	−0.4	+0.9

GROUP XIII—1891-1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	b_0	α_0	δ_1	ε	P	n	n′
1896, Feb. 21	Berlin	B. D. +25° 674	I	−0.96	+0.25	0.00	−0.14	−0.14	−0.13	+0.20	−0.08	−0.97	−3.4	−1.7
21	Berlin	B. D. +25° 677	I	−0.96	+0.25	0.00	+0.17	+0.17	−0.06	+0.20	+0.19	−0.97	−3.4	−1.7
21	Berlin	B. D. +25° 678	I	−0.91	+0.24	0.00	−0.34	−0.34	−0.14	+0.18	−0.28	−0.92	−1.4	+0.2
22	Berlin	B. D. +27° 702	I	−0.95	+0.03	+0.05	+0.31	+0.32	−0.09	+0.10	+0.36	−0.87	−1.9	−0.2
22	Berlin	B. D. +27° 712	I	−0.88	+0.03	+0.09	+0.46	+0.47	−0.06	+0.09	+0.49	−0.81	−1.5	+0.1
22	Berlin	Anon.	I	−0.99	+0.03	−0.02	−0.12	−0.12	−0.13	+0.09	−0.08	−0.91	−3.0	−1.3
22	Berlin	B. D. +27° 716	I	−0.73	+0.02	+0.13	+0.67	+0.68	−0.03	+0.07	+0.69	−0.67	−2.6	−1.3
22	Berlin	B. D. +27° 716	I	−0.72	+0.02	+0.13	+0.69	+0.70	−0.03	+0.07	+0.71	−0.66	−2.0	−0.7
22	Berlin	B. D. +27° 717	I	−0.99	+0.03	−0.03	−0.16	−0.16	−0.14	+0.10	−0.12	−0.91	−3.2	−1.5
22	Berlin	B. D. +27° 722	I	−0.97	+0.03	−0.05	−0.25	−0.26	−0.14	+0.08	−0.20	−0.89	−2.0	−0.3
22	Berlin	B. D. +27° 731	I	−0.91	+0.03	+0.09	+0.40	+0.41	−0.08	+0.07	+0.43	−0.84	−2.3	−0.7
22	Berlin	B. D. +27° 734	I	−0.76	+0.02	−0.14	−0.62	−0.64	−0.14	+0.07	−0.59	−0.70	−2.0	−0.7
23	Berlin	B. D. +27° 888	I	−0.97	−0.19	−0.12	−0.30	−0.32	−0.13	0.00	−0.29	−0.78	−3.7	−2.0
23	Berlin	B. D. +28° 918	I	−0.68	−0.13	−0.28	−0.70	−0.75	−0.08	−0.02	−0.72	−0.55	−2.4	−1.2
23	Berlin	B. D. +28° 939	I	−0.80	−0.16	−0.25	−0.58	−0.63	−0.10	−0.01	−0.60	−0.64	−1.1	+0.3
23	Berlin	B. D. +27° 909	I	−1.02	−0.20	−0.02	−0.05	−0.05	−0.13	−0.01	−0.02	−0.82	−4.1	−2.3
23	Berlin	B. D. +27° 912	I	−0.97	−0.20	−0.13	−0.30	−0.32	−0.13	−0.01	−0.29	−0.78	−2.7	−1.0
23	Berlin	B. D. +27° 913	I	−0.88	−0.17	−0.20	−0.46	−0.50	−0.11	−0.01	−0.48	−0.71	−2.2	−0.6
23	Berlin	B. D. +27° 915	I	−0.97	−0.20	−0.12	−0.29	−0.31	−0.12	−0.02	−0.27	−0.78	−3.2	−1.5
23	Berlin	B. D. +27° 914	I	−0.74	−0.15	+0.27	+0.63	+0.68	−0.10	−0.01	+0.71	−0.60	−1.8	−0.5
23	Berlin	B. D. +28° 955	I	−0.80	−0.16	−0.25	−0.57	−0.62	−0.09	−0.02	−0.59	−0.64	−2.3	−0.9
23	Berlin	B. D. +27° 932	I	−0.96	−0.19	+0.14	+0.31	+0.34	−0.13	−0.02	+0.38	−0.77	−1.8	−0.1
23	Berlin	B. D. +27° 933	I	−1.02	−0.20	−0.01	−0.02	−0.02	−0.14	−0.02	+0.02	−0.82	−3.7	−1.9
23	Berlin	B. D. +27° 940	I	−0.45	−0.09	+0.36	+0.83	+0.90	−0.08	0.00	+0.92	−0.36	+0.4	+1.2
23	Berlin	B. D. +27° 938	I	−0.35	−0.07	−0.38	+0.86	+0.94	−0.07	0.00	+0.95	−0.28	+1.4	+2.0
23	Berlin	415 B. Tauri	I	−0.72	−0.14	+0.28	+0.65	+0.71	−0.10	0.00	+0.73	−0.58	−1.9	0.6
23	Berlin	B. D. +27° 950	I	−1.01	−0.20	+0.06	+0.14	+0.15	−0.14	−0.03	+0.19	−0.81	−2.8	1.0
24	Berlin	B. D. +26° 1453	I	−0.59	−0.27	+0.55	+0.64	+0.83	−0.21	−0.08	+0.82	−0.36	−1.2	+0.2
24	Berlin	B. D. +25° 1594	I	−1.01	−0.46	+0.18	+0.21	+0.28	−0.21	−0.15	+0.32	−6.61	−1.7	+0.1
24	Berlin	B. D. +25° 1595	I	−1.02	−0.47	+0.16	+0.18	+0.24	−0.20	−0.15	+0.27	−0.62	−0.9	+0.9
24	Berlin	B. D. +25° 1596	I	−0.89	−0.41	+0.35	+0.40	+0.53	−0.22	−0.14	+0.55	−0.54	−2.8	1.2
24	Berlin	B. D. +26° 1485	I	−0.68	−0.31	−0.51	−0.59	−0.77	+0.01	−0.13	−0.71	−0.42	−3.4	[illegible]
24	Berlin	B. D. +25° 1608	I	−1.03	−0.47	+0.12	+0.14	+0.18	−0.20	−0.16	+0.22	−0.63	−2.0	−0.2
24	Berlin	49 Geminor.	I	−0.84	−0.38	−0.38	−0.45	−0.59	−0.04	−0.16	−0.54	−0.51	−1.3	+0.2
26	Berlin	78 Cancri	I	−1.04	−0.74	+0.30	+0.12	+0.32	−0.32	−0.33	+0.28	−0.31	−0.7	+1.1
Mar. 1	Greenwich	343 B. Virginis	E	+0.96	+0.81	+0.40	−0.36	+0.54	−0.03	+0.45	−0.20	−0.15	+1.0	+0.3
8	Cape	*h* Sagittarii	E	+0.81	−0.21	+0.40	+0.37	−0.55	−0.03	−0.18	+0.49	−0.75	+2.3	+1.2
19	Greenwich	18 Tauri	I	−0.90	+0.40	+0.20	+0.13	−0.24	−0.09	+0.22	−0.17	−0.91	−4.3	2.7
21	Berlin	B. D. +27° 799	I	−0.99	−0.09	−0.07	−0.20	−0.22	−0.13	+0.02	−0.17	−0.97	−3.1	1.3
21	Berlin	B. D. +27° 798	I	−0.54	−0.05	−0.28	−0.80	−0.85	−0.09	+0.03	−0.82	−0.52	−1.0	0.0
21	Berlin	B. D. +27° 803	I	−1.01	−0.09	+0.01	+0.04	+0.04	−0.13	+0.03	+0.08	−0.99	−3.9	2.1
21	Berlin	107 B. Aurigæ	I	−0.82	−0.07	+0.20	+0.56	+0.59	−0.09	+0.02	+0.61	−0.80	−3.8	2.3
21	Berlin	B. D. +27° 811	I	−0.91	−0.08	−0.15	−0.40	−0.43	−0.12	+0.02	−0.39	−0.89	−1.9	−0.3
21	Berlin	B. D. +27° 824	I	−0.82	−0.07	−0.21	−0.54	−0.58	−0.12	+0.03	−0.56	−0.80	−2.1	−0.6
21	Berlin	B. D. +27° 830	I	−0.54	−0.05	+0.31	+0.79	+0.85	−0.05	0.00	+0.87	−0.52	−2.3	1.3
21	Berlin	B. D. +27° 833	I	−0.94	−0.08	−0.13	−0.33	−0.36	−0.12	+0.02	−0.32	−0.92	−2.3	−0.0
21	Berlin	B. D. +27° 832	I	−0.42	−0.04	+0.34	+0.85	+0.91	−0.04	−0.01	+0.92	−0.42	+2.3	+3.0
21	Berlin	B. D. +27° 837	I	−1.00	−0.09	+0.05	+0.12	+0.13	−0.13	+0.01	+0.18	−0.98	−2.8	−1.0
21	Berlin	B. D. +27° 849	I	−0.81	−0.07	−0.22	−0.56	−0.60	−0.11	+0.01	−0.56	−0.79	−1.3	+0.2
22	Berlin	B. D. +27° 1144	I	−1.01	−0.30	−0.90	−0.14	−0.17	−0.12	−0.08	−0.14	−0.93	−2.8	−1.0
22	Berlin	B. D. +27° 1148	I	−0.84	−0.25	+0.31	+0.48	+0.57	−0.15	−0.07	+0.59	−0.78	[illegible]	[illegible]
22	Berlin	B. D. +27° 1104	I	−0.62	−0.10	−0.43	−0.67	−0.80	−0.01	+0.07	−0.77	−0.57	−1.8	0.7
22	Berlin	B. D. +27° 1167	I	−0.94	−0.28	+0.24	+0.35	+0.42	−0.17	−0.09	+0.45	−0.86	−2.0	0.3
22	Berlin	B. D. +27° 1181	I	−1.01	−0.30	+0.11	+0.16	+0.19	−0.16	−0.10	+0.23	−0.93	3.4	+0.4
22	Berlin	B. D. +26° 1317	I	−0.92	−0.28	+0.26	+0.38	+0.46	−0.18	−0.10	+0.49	−0.85	−2.3	[illegible]
22	Berlin	B. D. +26° 1333	I	−0.33	−0.10	+0.54	+0.78	+0.95	−0.14	−0.02	+0.95	−0.30	+2.3	[illegible]
22	Berlin	B. D. +26° 1330	I	−0.82	−0.25	+0.34	+0.46	+0.58	−0.17	−0.10	+0.63	−0.76	−2.3	[illegible]
23	Berlin	B. D. +25° 1700	I	−1.06	−0.52	+0.07	+0.06	+0.09	−0.18	−0.14	+0.12	−0.87	−2.2	[illegible]
23	Berlin	B. D. +25° 1709	I	−0.95	−0.47	−0.32	−0.30	−0.44	−0.09	−0.14	−0.37	−0.78	−2.1	[illegible]
23	Berlin	B. D. +25° 1725	I	−0.88	−0.43	−0.42	−0.37	−0.56	−0.06	−0.14	−0.48	−0.72	[illegible]	−0.1
23	Berlin	176 B. Geminor.	I	−0.82	−0.40	+0.46	+0.41	+0.62	−0.22	−0.11	+0.62	−0.67	−2.5	−1.0
23	Berlin	B. D. +24° 1729	I	−0.89	−0.44	+0.41	+0.36	+0.54	−0.21	−0.11	+0.54	−0.73	−1.3	[illegible]
23	Berlin	181 B. Geminor.	I	−0.67	−0.33	+0.58	+0.52	+0.78	−0.22	−0.09	+0.75	−0.55	−1.4	[illegible]
23	Berlin	B. D. +24° 1740	I	−0.90	−0.44	+0.40	+0.34	+0.53	−0.22	−0.11	+0.53	−0.74	−1.4	[illegible]
23	Berlin	B. D. +24° 1746	I	−1.06	−0.52	+0.01	+0.01	+0.01	−0.17	−0.16	+0.06	−0.87	−3.3	[illegible]
23	Berlin	B. D. +24° 1750	I	−0.66	−0.32	+0.60	+0.51	+0.70	−0.27	−0.12	+0.76	−0.54	−1.4	[illegible]
23	Berlin	B. D. +24° 1755	I	−0.51	−0.25	−0.67	−0.57	−0.88	−0.09	−0.15	−0.79	−0.42	−2.1	[illegible]
25	Berlin	B. D. +15° 2075	I	−1.08	−p.84	+0.16	+0.04	+0.17	−0.27	−0.38	+0.17	−0.57	−0.5	[illegible]
25	Berlin	B. D. +15° 2079	I	−0.92	−0.71	+0.52	+0.11	+0.53	−0.38	−0.30	+0.38	−0.49	−2.7	[illegible]
25	Berlin	B. D. +15° 2080	I	−0.93	−0.72	+0.51	+0.11	+0.52	−0.38	−0.30	+0.38	−0.49	−3.0	[illegible]

GROUP XIII—1891–1908—Continued.

Date.		Place.	Star.	Ph.	l	κ	m	i	b_0	α_0	δ_0	ε	l'	n	n'
														″	″
1896, Mar.	25	Berlin	11 Leonis	I	−0.96	−0.75	+0.46	+0.10	+0.47	−0.36	−0.31	+0.35	−0.51	−2.3	−0.6
	25	Berlin	B. D. +15° 2091	I	−1.06	−0.82	−0.22	−0.05	−0.22	−0.12	−0.40	−0.08	−0.56	−3.3	−1.4
	27	Greenwich	79 Leonis	I	−0.86	−0.73	+0.64	−0.19	+0.67	−0.51	−0.27	+0.15	−0.20	+0.3	+1.8
	27	Greenwich	79 Leonis	EB	+1.06	+0.90	+0.37	−0.12	+0.39	+0.06	+0.47	+0.02	+0.25	−1.3	−2.8
Apr.	1	Santiago	α Scorpii	IB	−0.93	−0.46	+0.05	+0.48	−0.49	−0.08	−0.15	+0.48	+0.63	+0.3	+2.0
	1	Santiago	α Scorpii	E	+0.68	+0.33	+0.08	+0.76	−0.77	+0.41	+0.09	+0.70	−0.46	+1.3	+0.3
	1	Santiago	116 B. Scorpii	IB	−0.77	−0.38	+0.08	+0.68	−0.69	−0.03	−0.12	+0.63	+0.53	−4.3	−2.9
	1	Santiago	116 B. Scorpii	E	+0.43	+0.21	+0.11	+0.91	−0.91	+0.20	+0.06	+0.83	−0.30	+0.2	−0.4
	7	Cape	μ Capricor.	E	+0.92	−0.73	0.00	0.00	0.00	+0.05	−0.42	−0.05	−0.85	+1.4	+0.1
	15	Berlin	B. D. +23° 462	I	−0.85	+0.41	−0.05	+0.45	+0.45	+0.04	+0.25	+0.41	−0.58	−4.0	−2.5
	15	Berlin	B. D. +23° 463	I	−0.84	+0.40	−0.06	+0.48	+0.38	+0.04	+0.23	+0.43	−0.57	−3.4	−1.9
	15	Berlin	B. D. +23° 469	I	−0.95	+0.46	0.00	−0.02	−0.02	−0.08	+0.26	+0.03	−0.65	−3.4	−1.7
	17	Santiago	β Tauri	I	−0.17	+0.02	+0.34	+0.92	+0.98	+0.03	+0.01	+0.98	−0.17	+1.7	+2.0
	17	Santiago	β Tauri	EB	+0.24	−0.02	+0.34	+0.91	+0.97	+0.06	−0.01	+0.96	+0.22	+1.0	+0.5
	19	Hamburg	A Geminor.	I	−0.83	−0.30	−0.42	−0.29	−0.57	0.00	−0.18	−0.49	−0.82	−1.6	−0.1
	20	Berlin	B. D. +22° 1901	I	−1.07	−0.63	−0.02	−0.01	−0.02	−0.18	−0.29	+0.03	−0.97	−4.0	−2.1
	20	Berlin	B. D. +21° 1807	I	−1.04	−0.61	+0.21	+0.13	+0.26	−0.25	−0.26	+0.27	−0.94	−1.3	+0.6
	22	Kasan	ν Leonis	I	−0.91	−0.71	−0.54	−0.05	−0.54	+0.05	−0.39	−0.26	−0.77	−0.6	+1.0
	22	Cape	α Leonis	I	−1.03	−0.83	+0.35	0.00	+0.35	−0.36	−0.37	+0.22	−0.78	−0.9	+1.0
	25	Cape	ψ Virginis	I	−1.09	−0.96	+0.15	−0.15	+0.21	−0.33	−0.42	0.00	−0.32	+0.9	+2.9
	26	Greenwich	83 Virginis	I	−1.15	−0.93	+0.01	−0.02	+0.02	−0.28	−0.41	+0.03	+0.16	−2.3	−0.2
	26	Berlin	83 Virginis	I	−1.05	−0.88	−0.18	+0.27	−0.32	−0.09	−0.31	+0.20	−0.15	−1.0	+0.3
May	1	Cape	σ Sagittarii	IB	−0.70	+0.13	+0.45	+0.54	−0.70	−0.18	+0.09	+0.73	+0.57	+0.5	+1.8
	1	Cape	σ Sagittarii	E	+0.49	−0.09	+0.56	+0.67	−0.87	−0.04	−0.08	+0.71	−0.40	+2.0	+1.3
	1	Santiago	201 B. Sagittarii	EB	+0.99	+0.06	+0.09	+0.09	−0.13	+0.09	−0.18	+0.07	−0.78	0.0	−1.4
	16	Berlin	B. D. +25° 1570	I	−0.99	−0.30	−0.20	−0.20	−0.28	−0.10	−0.17	−0.21	−0.83	−2.5	−0.7
	16	Berlin	B. D. +25° 1579	I	−0.90	−0.27	−0.36	−0.36	−0.50	−0.06	−0.16	−0.44	−0.75	−1.7	−0.1
	16	Berlin	B. D. +25° 1590	I	−1.02	−0.31	−0.12	−0.11	−0.16	−0.12	−0.18	−0.11	−0.85	−2.4	−0.5
	16	Berlin	B. D. +25° 1584	I	−0.23	−0.07	+0.70	+0.68	+0.97	−0.19	−0.03	+0.97	−0.19	+1.8	+2.2
	17	Berlin	B. D. +22° 1836	I	−1.03	−0.48	+0.19	+0.13	+0.23	−0.22	−0.25	+0.25	−0.91	+0.8	+2.7
	17	Berlin	B. D. +22° 1834	I	−0.82	−0.38	+0.54	+0.35	+0.64	−0.29	−0.18	+0.63	−0.72	−0.6	+0.9
	17	Berlin	B. D. +22° 1852	I	−1.06	−0.50	−0.04	−0.03	−0.05	−0.16	−0.27	+0.01	−0.94	−2.3	−0.4
	20	Cape	ρ Leonis	I	−0.93	−0.75	+0.53	−0.05	+0.53	−0.43	−0.32	+0.25	−0.84	−1.9	−0.2
	21	Berlin	B. D. + 0° 2801	I	−0.31	−0.27	+0.88	−0.38	+0.96	−0.53	−0.02	+0.16	−0.24	+0.8	+1.4
	21	Berlin	υ Leonis	I	−1.11	−0.98	−0.04	+0.02	−0.04	−0.21	−0.45	+0.06	−0.90	−3.1	−1.1
	21	Greenwich	υ Leonis	I	−1.09	−0.97	+0.12	−0.05	+0.13	−0.27	−0.45	+0.07	−0.89	+0.3	+2.3
	23	Berlin	B. D. −12° 3785	I	−0.99	−0.94	−0.26	+0.33	−0.42	0.00	−0.40	+0.20	−0.55	−3.0	−1.1
	25	Berlin	C. D. −23° 12133	I	−1.03	−0.67	+0.04	−0.30	+0.30	−0.27	−0.27	−0.17	−0.22	−2.7	−0.8
	25	Berlin	C. D. −23° 12202	I	−0.72	−0.48	−0.09	+0.75	−0.75	+0.06	−0.21	+0.63	−0.15	−1.3	0.0
	25	Berlin	C. D. −23° 12208	I	−0.51	−0.33	−0.11	+0.89	−0.89	+0.12	−0.17	+0.72	−0.11	−1.1	−0.2
	26	Santiago	α Scorpii	I	−1.02	−0.56	−0.05	−0.36	+0.36	−0.24	−0.14	−0.29	−0.06	−1.2	+0.7
	26	Cape	α Scorpii	IB	−0.76	−0.39	+0.12	+0.08	−0.70	−0.05	−0.11	+0.09	0.00	−0.6	+0.8
	26	Cape	α Scorpii	E	+0.94	+0.48	+0.08	+0.45	−0.46	+0.22	+0.13	+0.30	0.00	+1.0	+0.4
	31	Berlin	30 Capricor.	E	+0.86	−0.53	−0.39	−0.09	+0.39	+0.19	−0.34	+0.31	−0.81	+2.0	+0.7
June	2	Berlin	B. D. − 8° 5961	E	+0.53	−0.52	−0.81	+0.02	+0.81	+0.38	−0.18	+0.31	−0.59	−0.2	−0.9
	2	Berlin	B. D. − 7° 5873	E	+0.20	−0.19	+0.97	−0.02	−0.97	−0.43	−0.20	+0.35	−0.22	+1.3	+1.0
	2	Berlin	B. D. − 8° 5964	E	+0.74	−0.72	−0.57	+0.01	+0.57	+0.27	−0.31	−0.24	−0.82	+0.9	−0.2
	3	Berlin	14 Piscium	E	+0.65	−0.63	+0.63	−0.27	−0.69	−0.31	−0.40	+0.06	[illegible]	+2.2	+1.2
	14	Berlin	B. D. +19° 2094	I	−1.06	−0.60	−0.14	−0.05	−0.15	−0.13	−0.33	+0.07	−0.80	−2.7	−0.7
	14	Berlin	B. D. +19° 2095	I	−1.07	−0.61	0.00	0.00	0.00	−0.18	−0.32	+0.05	−0.79	−0.9	+1.1
	14	Berlin	B. D. +19° 2097	I	−0.28	−0.16	−0.89	−0.35	−0.97	+0.26	−0.15	−0.75	−0.21	−2.4	−1.0
	15	Berlin	B. D. +14° 2123	I	−1.08	−0.72	+0.12	+0.02	+0.12	−0.25	−0.37	+0.15	−0.89	−0.4	+1.0
	19	Cape	ψ Virginis	I	−0.92	−0.83	+0.37	−0.40	+0.33	−0.46	−0.32	−0.30	−0.80	−2.0	−0.3
	22	Cape	A Scorpii	I	−1.07	−0.68	0.00	−0.03	+0.03	−0.21	−0.22	+0.01	−0.58	−1.6	+0.4
	22	Berlin	C. D. −26° 11106	I	−0.77	[illegible]	−0.04	−0.70	+0.70	−0.27	−0.14	[illegible]	−0.42	−4.6	−3.1
	22	Greenwich	4 Scorpii	I	−0.63	−0.40	+0.04	+0.81	−0.81	+0.04	−0.14	+0.74	−0.34	−1.1	+0.1
	24	Greenwich	28 B. Sagittarii	I	−0.89	−0.24	+0.28	+0.44	−0.52	−0.15	+0.04	+0.50	−0.14	−1.2	+0.5
July	6	Berlin	B. D. +24° [illegible]	E	+0.91	−0.54	+0.01	+0.22	+0.22	+0.10	−0.22	+0.16	−0.90	+2.1	+0.7
	6	Berlin	B. D. +24° [illegible]	E	+0.93	−0.55	−0.01	−0.15	−0.15	+0.03	−0.22	−0.18	−0.61	+3.2	+1.8
	6	Berlin	B. D. +24° 593	E	+0.64	−0.38	+0.04	+0.73	+0.73	+0.17	−0.12	+0.62	−0.42	+0.6	−0.4
	20	Greenwich	τ Scorpii	EB	+0.91	+0.55	−0.12	−0.48	+0.49	+0.08	+0.12	−0.50	+0.70	−2.6	−4.0
	20	Pola	τ Scorpii	I	−0.86	−0.52	−0.13	−0.55	+0.56	−0.20	−0.11	−0.48	−0.07	−1.0	+0.6
	27	Berlin	B. D. − 6° [illegible]	E	+0.82	−0.77	+0.42	−0.12	−0.44	−0.18	−0.46	+0.09	−0.54	+3.1	+1.9
	27	Berlin	B. D. − 6° [illegible]	E	+0.88	−0.83	+0.22	−0.06	−0.23	−0.08	−0.48	+0.03	+0.58	+3.3	+2.0
	27	Berlin	B. D. − 6° [illegible]	E	+0.33	−0.32	−0.89	+0.26	+0.93	+0.42	−0.07	−0.29	−0.22	−1.8	−2.3
	28	Greenwich	21 Piscium	E	+0.58	−0.58	−0.65	+0.40	+0.77	+0.41	−0.19	−0.08	−0.36	+0.9	0.0
	31	Cape	ε Arietis	E	+0.84	−0.88	+0.14	−0.34	−0.36	−0.11	−0.38	−0.25	−0.93	+4.5	+3.2
Aug.	5	Berlin	B. D. +26° [illegible]	E	+1.09	+0.88	−0.10	−0.13	−0.17	+0.23	+0.08	−0.20	−0.67	+4.8	+3.2
	5	Berlin	B. D. +26° [illegible]	E	+1.07	+0.86	−0.16	−0.20	−0.25	[illegible]	+0.08	−0.24	−0.66	[illegible]	+3.0
	5	Berlin	B. D. +26° 1430	E	+1.05	+0.85	+0.19	+0.24	+0.31	+0.19	+0.00	+0.30	−0.65	+3.9	+2.3

GROUP XIII—1891-1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_1	a_0	δ_0	ϵ	P	n	n'
													″	″
1896, Aug. 5	Berlin	B. D. +27° 1122	E	+0.53	+0.43	−0.55	−0.69	−0.88	+0.19	+0.04	+0.91	−0.33	+1.5	+0.7
20	Cape	4 Capricor.	I	−0.97	+0.14	−0.14	−0.06	+0.15	−0.10	+0.29	−0.08	−0.57	−0.4	+1.5
21	Berlin	B. D. −18° 5875	IB	−0.95	+0.44	−0.09	−0.02	+0.09	−0.04	+0.39	−0.03	−0.31	−1.1	+0.8
23	Berlin	B. D. − 8° 5932	E	+0.68	−0.59	−0.63	+0.16	+0.65	+0.32	−0.28	−0.27	−0.09	−3.1	−4.1
27	Berlin	B. D. +14° 249	E	+0.79	−0.85	+0.22	−0.40	−0.46	−0.18	−0.40	−0.25	−0.75	+2.8	+1.6
28	Berlin	B. D. +17° 346	E	+0.89	−0.88	+0.03	−0.12	−0.12	−0.03	−0.38	−0.12	−0.91	+2.8	+1.5
28	Berlin	B. D. +18° 300	E	+0.83	−0.82	+0.12	−0.38	−0.40	−0.11	−0.35	−0.29	−0.85	+2.5	+1.2
28	Berlin	B. D. +18° 305	E	+0.31	−0.30	−0.26	+0.90	+0.94	+0.32	−0.06	+0.56	−0.31	+0.5	0.0
28	Berlin	B. D. +18° 312	E	+0.71	−0.70	−0.16	+0.57	+0.61	+0.21	−0.24	+0.16	−0.73	+1.8	+0.7
28	Berlin	B. D. +19° 362	E	+0.38	−0.37	+0.24	−0.88	−0.91	−0.28	−0.21	−0.60	−0.39	+2.1	+1.5
28	Berlin	26 Arietis	E	+0.84	−0.83	+0.10	−0.37	−0.38	−0.10	−0.42	−0.29	−0.86	+3.6	+2.3
29	Berlin	B. D. +21° 418	E	+0.89	−0.74	−0.02	+0.24	+0.24	+0.09	−0.27	+0.12	−0.95	+2.2	+0.8
29	Berlin	B. D. +21° 423	E	+0.76	−0.63	−0.04	+0.55	+0.55	+0.16	−0.22	+0.38	−0.81	+0.8	−0.4
29	Berlin	B. D. +22° 455	E	+0.84	−0.69	+0.03	−0.40	−0.40	−0.08	−0.25	−0.36	−0.89	+1.3	0.0
29	Berlin	161 B. Arietis	E	+0.72	−0.59	+0.04	−0.62	−0.62	−0.13	−0.24	−0.51	−0.76	+0.7	−0.4
29	Berlin	B. D. +22° 465	E	+0.91	−0.75	+0.01	−0.17	−0.17	−0.01	−0.25	−0.19	−0.97	+2.3	+0.9
30	Berlin	B. D. +25° 678	E	+0.67	−0.53	−0.12	−0.68	−0.69	−0.08	−0.14	−0.66	−0.72	+0.5	−0.5
Sept. 3	Berlin	B. D. +22° 1810	E	+0.66	+0.19	+0.68	+0.37	+0.77	−0.09	+0.21	+0.65	−0.40	+2.0	+1.0
3	Berlin	B. D. +22° 1834	E	+0.62	+0.17	+0.71	+0.38	+0.80	−0.10	+0.20	+0.69	−0.37	+1.9	+0.9
5	Cape	α Leonis	IB	−0.59	−0.38	−0.84	+0.07	−0.84	+0.23	−0.32	−0.42	+0.12	−1.7	−0.7
14	Berlin	C. D. −28° 14143	I	−0.98	−0.36	+0.20	+0.27	−0.34	−0.16	+0.05	+0.39	−0.94	+0.1	+2.0
14	Berlin	C. D. −28° 14144	I	−0.42	−0.15	+0.55	+0.74	−0.92	−0.11	+0.01	+0.94	−0.40	+0.6	+1.4
14	Berlin	38 B. Sagittarii	I	−0.94	−0.34	+0.25	+0.34	−0.42	−0.16	+0.06	+0.48	−0.90	+0.3	+2.2
18	Cape	42 Capricor.	I	−0.93	+0.41	−0.21	−0.01	+0.21	+0.01	+0.41	−0.09	−0.67	−1.8	+0.1
23	Berlin	B. D. +11° 172	E	+0.89	−1.00	+0.04	−0.06	−0.07	−0.02	−0.43	−0.08	−0.40	+4.6	+3.2
26	Berlin	17 Tauri	E	+0.48	−0.36	+0.08	+0.86	+0.86	+0.20	−0.09	+0.71	−0.45	+0.2	−0.6
26	Berlin	B. D. +23° 504	E	+0.87	−0.66	−0.03	−0.30	−0.30	−0.03	−0.21	−0.30	−0.83	+3.3	+1.9
26	Berlin	16 Tauri	E	+0.92	−0.70	−0.01	−0.07	−0.07	+0.10	−0.22	−0.11	−0.87	+2.4	+0.9
26	Berlin	q Tauri	E	+0.86	−0.66	−0.04	−0.34	−0.34	−0.03	−0.21	−0.34	−0.82	+2.5	+1.1
26	Berlin	B. D. +23° 519	E	+0.32	−0.24	+0.10	+0.93	+0.93	+0.20	−0.06	+0.81	−0.30	−0.8	−1.3
26	Berlin	B. D. +23° 512	E	+0.87	−0.66	+0.03	+0.30	+0.30	+0.08	−0.19	+0.22	−0.83	+1.3	−0.1
26	Berlin	B. D. +24° 550	E	+0.90	−0.69	−0.02	−0.20	−0.20	0.00	−0.21	−0.24	−0.85	+3.1	+1.7
26	Berlin	20 Tauri	E	+0.90	−0.68	+0.03	+0.24	+0.24	+0.08	−0.20	+0.16	−0.84	+1.5	+1.1
26	Berlin	B. D. +23° 523	E	+0.53	−0.41	+0.09	+0.82	+0.82	+0.17	−0.09	+0.67	−0.50	+1.0	+0.2
26	Berlin	21 Tauri	E	+0.82	−0.62	−0.05	−0.46	−0.46	−0.05	−0.19	−0.44	−0.77	+3.2	+1.9
26	Berlin	22 Tauri	E	+0.87	−0.66	−0.03	−0.31	−0.31	−0.03	−0.21	−0.32	−0.83	+2.9	+1.5
26	Berlin	B. D. +23° 540	E	+0.24	−0.18	+0.11	+0.97	+0.97	+0.20	−0.03	+0.81	−0.23	−1.5	−1.9
26	Berlin	B. D. +24° 562	E	+0.92	−0.70	0.00	+0.04	+0.04	+0.05	−0.22	−0.03	−0.87	+4.1	+2.6
26	Berlin	B. D. +24° 566	E	+0.92	−0.70	−0.01	−0.10	−0.10	+0.03	−0.23	−0.14	−0.87	+2.5	+1.0
26	Berlin	B. D. +24° 567	E	+0.86	−0.65	−0.04	−0.36	−0.36	−0.03	−0.21	−0.36	−0.81	+1.7	+0.3
26	Berlin	B. D. +24° 577	E	+0.78	−0.60	+0.07	+0.51	+0.52	+0.12	−0.16	+0.40	−0.74	+1.9	+0.7
26	Berlin	B. D. +24° 587	E	+0.56	−0.43	−0.11	−0.79	−0.80	−0.12	−0.15	−0.92	−0.53	+2.7	+1.8
26	Berlin	B. D. +24° 598	E	+0.92	−0.70	+0.01	+0.04	+0.04	+0.05	−0.21	−0.01	−0.87	+3.7	+2.2
28	Berlin	B. D. +27° 818	E	+0.96	−0.20	−0.06	−0.10	−0.12	+0.09	0.00	−0.18	−0.99	+1.9	+0.4
28	Berlin	B. D. +27° 832	E	+0.84	−0.25	−0.27	−0.42	−0.50	+0.07	0.00	−0.34	−0.87	+1.6	+0.2
28	Berlin	B. D. +27° 846	E	+0.90	−0.27	+0.19	+0.30	+0.36	+0.08	0.00	+0.30	−0.93	+1.3	−0.1
28	Berlin	B. D. +27° 850	E	+0.75	−0.22	+0.35	+0.54	+0.64	+0.06	−0.03	−0.61	−0.77	+3.0	+1.8
28	Berlin	B. D. +27° 856	E	+0.80	−0.24	+0.31	+0.47	+0.57	+0.07	+0.01	+0.53	−0.82	+2.1	+0.8
28	Berlin	B. D. +27° 866	E	+0.38	−0.11	−0.50	−0.77	−0.92	+0.04	0.00	−0.94	−0.39	−0.1	−0.7
29	Berlin	B. D. +26° 1276	E	+0.97	−0.07	−0.13	−0.14	−0.19	+0.12	+0.12	−0.25	−0.96	+1.8	[illegible]
29	Berlin	B. D. +26° 1292	E	+0.78	−0.06	+0.42	+0.43	+0.60	+0.02	+0.07	+0.56	−0.77	+2.7	[illegible]
29	Berlin	B. D. +26° 1298	E	+0.99	−0.07	+0.04	+0.04	+0.05	0.00	+0.13	−0.02	−0.99	+2.2	[illegible]
29	Berlin	B. D. +26° 1304	E	+0.68	−0.05	−0.51	−0.51	−0.72	+0.15	+0.09	−0.76	−0.68	+1.6	+0.5
29	Berlin	B. D. +26° 1300	E	+0.95	−0.07	−0.18	−0.18	−0.26	+0.12	+0.12	−0.31	−0.94	+1.4	−0.1
29	Berlin	B. D. +26° 1302	E	+0.86	−0.06	+0.34	+0.34	+0.48	+0.03	+0.10	+0.44	[illegible]	+1.0	[illegible]
29	Berlin	B. D. +26° 1308	E	+0.98	−0.07	+0.08	+0.08	+0.11	+0.09	+0.13	+0.05	−0.97	+3.1	+1.5
29	Berlin	B. D. +26° 1309	E	+0.75	−0.05	+0.45	+0.45	+0.64	+0.01	+0.08	+0.60	−0.74	+2.4	[illegible]
29	Berlin	B. D. +26° 1311	E	+0.57	−0.04	+0.58	+0.58	+0.81	−0.03	+0.06	+0.78	−0.57	+0.9	0.0
29	Berlin	B. D. +26° 1326	E	+0.47	−0.03	−0.63	−0.62	−0.88	+0.15	+0.07	−0.90	−0.46	[illegible]	[illegible]
29	Berlin	B. D. +26° 1321	E	+0.97	−0.07	−0.12	−0.12	−0.17	+0.12	+0.13	−0.24	−0.95	[illegible]	[illegible]
29	Berlin	B. D. +26° 1322	E	+0.93	−0.07	+0.24	+0.24	+0.34	+0.06	+0.12	+0.29	−0.92	[illegible]	[illegible]
29	Berlin	B. D. +26° 1327	E	+0.65	−0.05	+0.54	+0.53	+0.76	−0.02	+0.09	+0.70	−0.65	[illegible]	[illegible]
29	Berlin	B. D. +26° 1331	E	+0.94	−0.07	−0.22	−0.22	−0.31	+0.13	+0.13	−0.36	−0.93	+0.9	[illegible]
29	Berlin	B. D. +26° 1332	E	+0.98	−0.07	−0.12	−0.12	−0.17	+0.12	+0.12	−0.21	−0.97	+2.1	[illegible]
29	Berlin	B. D. +26° 1333	E	+0.97	−0.07	−0.13	−0.13	−0.18	+0.12	+0.13	−0.24	−0.96	+1.0	[illegible]
29	Berlin	B. D. +26° 1338	E	+0.86	−0.06	+0.35	+0.34	+0.49	+0.03	+0.11	+0.43	−0.85	+2.0	+0.6
29	Berlin	B. D. +26° 1342	E	+0.67	−0.05	+0.53	+0.50	+0.73	−0.02	−0.09	+0.65	−0.67	+1.8	+0.7
Oct. 9	Cape	α Scorpii	I	−0.99	−0.71	+0.10	+0.38	−0.39	−0.14	−0.13	+0.41	−0.61	−0.8	+1.2
10	Cape	α Scorpii	EB	+0.80	+0.57	+0.19	+0.64	−0.67	+0.21	+0.07	+0.55	+0.49	+0.8	−0.5
16	Kasan	ε Aquarii	I	−0.93	+0.48	−0.03	0.00	+0.03	−0.06	+0.41	+0.09	−0.89	+0.5	+2.4

GROUP XIII—1891–1908—Continued.

Date.		Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
														″	″
1896, Oct.	18	Berlin	B. D. − 0° 4558	I	−0.89	+0.88	−0.06	+0.04	+0.07	+0.02	+0.47	+0.04	−0.54	−2.8	−1.0
	24	Berlin	B. D. +25° 703	E	+0.74	−0.51	−0.15	−0.56	−0.58	−0.06	−0.10	−0.59	−0.53	+0.5	−0.7
	24	Berlin	χ Tauri	E	+0.70	−0.48	+0.17	+0.65	+0.67	+0.12	−0.11	+0.57	−0.50	+2.4	+1.2
	25	Berlin	B. D. +26° 827	E	+0.83	−0.50	+0.24	+0.40	+0.47	+0.05	−0.01	+0.41	−0.62	+1.0	−0.4
	27	Berlin	B. D. +25° 1597	E	+0.84	−0.06	−0.42	−0.30	−0.52	+0.17	−0.16	−0.55	−0.82	+0.4	−1.0
	27	Berlin	B. D. +24° 1549	E	+0.45	−0.03	+0.72	+0.52	+0.89	−0.10	−0.10	+0.83	−0.43	+1.3	+0.6
	27	Berlin	B. D. +24° 1562	E	+0.74	−0.05	+0.52	+0.38	+0.65	−0.03	+0.13	+0.59	−0.72	+1.8	+0.6
	27	Berlin	B. D. +24° 1567	E	+0.59	−0.04	+0.65	+0.46	+0.80	−0.08	+0.11	+0.75	−0.58	+1.6	+0.6
	27	Berlin	B. D. +24° 1576	E	+0.84	−0.06	+0.42	+0.30	+0.52	0.00	+0.16	+0.46	−0.82	+2.3	+0.9
	27	Berlin	52 Geminor.	E	+0.97	−0.07	−0.14	−0.10	−0.17	+0.13	+0.19	−0.23	−0.94	+1.4	−0.2
	27	Berlin	B. D. +25° 1625	E	+0.92	−0.07	−0.28	−0.21	−0.36	+0.17	+0.19	−0.40	−0.89	+1.0	−0.5
	27	Berlin	B. D. +24° 1627	E	+0.99	−0.07	−0.05	−0.03	−0.06	+0.12	+0.20	−0.11	−0.96	+1.2	−0.4
	27	Greenwich	52 Geminor.	IB	−0.80	+0.06	−0.45	−0.33	−0.56	+0.03	−0.16	−0.50	−0.80	−3.2	−1.6
	30	Berlin	B. D. +11° 2153	E	+1.01	+0.49	+0.30	−0.03	+0.30	+0.04	+0.44	+0.10	−0.90	+0.7	−0.9
	30	Berlin	B. D. +11° 2162	E	+1.06	+0.52	0.00	0.00	0.00	+0.17	+0.41	−0.07	−0.95	+1.0	−0.7
Nov.	9	Cape	χ Sagittarii	I	−0.55	−0.15	−0.72	−0.45	+0.85	+0.07	+0.13	−0.77	−0.41	−3.4	−2.3
	9	Cape	χ Sagittarii	EB	+0.19	+0.05	−0.83	−0.52	+0.98	+0.20	−0.01	−0.93	+0.15	−1.7	−2.0
	9	Cape	49 Sagittarii	I	−0.32	−0.08	+0.81	+0.50	−0.95	−0.22	+0.03	+0.91	−0.24	−0.5	+0.1
	10	Berlin	B. D. −22° 5389	I	−0.95	+0.03	+0.31	+0.10	−0.32	−0.21	+0.27	+0.33	−0.87	−1.9	0.0
	12	Berlin	B. D. −12° 6153	I	−0.72	+0.36	+0.64	−0.07	−0.64	−0.32	+0.27	+0.40	−0.76	−0.8	+0.7
	12	Berlin	B. D. −12° 6152	I	−0.71	+0.36	+0.67	−0.07	−0.67	−0.33	+0.25	+0.41	−0.75	−1.1	+0.4
	13	Berlin	B. D. − 7° 5837	I	−0.85	+0.59	+0.39	−0.12	−0.41	−0.23	+0.37	+0.21	−0.88	−1.0	+0.7
	13	Berlin	B. D. − 7° 5847	I	−0.82	+0.57	+0.46	−0.15	−0.48	−0.22	+0.35	+0.22	−0.85	−1.4	+0.3
	13	Berlin	B. D. − 7° 5858	I	−0.84	+0.58	−0.42	+0.14	+0.44	+0.15	+0.46	−0.11	−0.87	−2.9	−1.2
	13	Berlin	B. D. − 7° 5861	I	−0.89	+0.62	−0.27	+0.09	+0.28	+0.08	+0.48	−0.05	−0.93	−2.8	−1.0
	13	Berlin	B. D. − 7° 5866	I	−0.44	+0.31	−0.85	+0.28	+0.89	+0.37	+0.31	−0.29	−0.46	−2.1	−1.2
	15	Berlin	B. D. + 3° 10	I	−0.53	+0.54	+0.61	−0.53	−0.81	−0.34	+0.17	+0.01	−0.46	−1.4	−0.3
	15	Berlin	B. D. + 3° 15	I	−0.90	+0.92	+0.04	−0.03	−0.05	−0.03	+0.45	+0.05	−0.78	−3.5	−1.7
	15	Berlin	B. D. + 4° 22	I	−0.78	+0.80	+0.37	−0.33	−0.49	−0.23	+0.35	+0.02	−0.68	−1.1	+0.5
	16	Berlin	B. D. + 8° 126	I	−0.80	+0.88	−0.25	+0.34	+0.42	+0.19	+0.43	+0.14	−0.58	−1.9	−0.3
	16	Berlin	B. D. + 9° 110	I	−0.83	+0.91	+0.21	−0.29	−0.36	−0.16	+0.37	−0.04	−0.60	−2.4	−0.7
	16	Berlin	B. D. + 9° 109	I	−0.51	+0.56	+0.48	−0.66	−0.82	−0.36	+0.17	−0.17	−0.36	−1.1	−0.1
	16	Berlin	B. D. +10° 123	I	−0.63	+0.70	+0.40	−0.59	−0.71	−0.30	+0.23	−0.15	−0.45	−1.2	+0.1
	17	Berlin	104 Piscium	I	−0.44	+0.50	−0.37	+0.78	+0.87	+0.35	+0.28	+0.38	−0.24	−1.8	−0.9
	26	Berlin	B. D. +13° 2131	E	+1.06	+0.55	−0.09	0.00	−0.09	+0.21	+0.38	−0.13	−0.99	+0.8	−1.0
	26	Berlin	47 B. Leonis	E	+0.99	+0.51	+0.36	−0.01	+0.36	+0.02	+0.40	+0.16	−0.92	+1.3	−0.4
	26	Berlin	B. D. +13° 2139	E	+0.90	+0.47	+0.52	−0.02	+0.52	−0.06	+0.39	+0.27	−0.84	+2.3	+0.8
	26	Berlin	B. D. +13° 2147	E	+0.64	+0.33	+0.80	−0.04	+0.80	−0.21	+0.33	+0.45	−0.59	+2.2	+1.1
Dec.	16	Berlin	B. D. +22° 438	I	−0.82	+0.82	0.00	−0.40	−0.40	−0.12	+0.25	−0.25	−0.54	−4.2	−2.5
	17	Berlin	17 Tauri	I	−0.88	+0.85	+0.04	+0.21	+0.21	+0.03	+0.21	+0.23	−0.46	−2.4	−0.6
	17	Berlin	20 Tauri	I	−0.79	+0.77	−0.08	−0.47	−0.48	−0.10	+0.17	−0.36	−0.41	−2.9	−1.2
	17	Berlin	η Tauri	I	−0.23	+0.23	−0.16	−0.95	−0.97	−0.18	+0.03	−0.81	−0.12	−1.7	−1.2
	17	Berlin	B. D. +23° 523	I	−0.89	+0.86	+0.02	+0.13	+0.13	+0.02	+0.22	+0.16	−0.47	−3.3	−1.4
	17	Berlin	B. D. +24° 562	I	−0.66	+0.64	−0.12	−0.68	−0.69	−0.14	+0.14	−0.54	−0.34	−1.4	0.0
	17	Berlin	B. D. +23° 540	I	−0.86	+0.83	+0.06	+0.31	+0.32	+0.04	+0.20	+0.32	−0.45	−0.8	+1.0
	17	Berlin	B. D. +24° 566	I	−0.54	+0.52	−0.14	−0.78	−0.80	−0.17	+0.11	−0.65	−0.28	−1.9	−0.8
	17	Berlin	B. D. +23° 553	I	−0.82	+0.79	+0.08	+0.40	+0.41	+0.07	+0.19	+0.39	−0.43	−2.1	−0.4
	17	Berlin	B. D. +23° 560	I	−0.79	+0.77	+0.09	+0.45	+0.46	+0.08	+0.18	+0.44	−0.41	−2.5	−0.8
	17	Berlin	B. D. +23° 561	I	−0.75	+0.72	+0.11	+0.55	+0.56	+0.09	+0.19	+0.52	−0.39	−3.0	1.4
	17	Berlin	B. D. +23° 567	I	−0.33	+0.32	+0.18	+0.91	+0.93	+0.18	−0.09	+0.81	−0.17	−1.6	−0.9
	17	Berlin	B. D. +24° 578	I	0.80	+0.77	+0.09	+0.45	+0.46	+0.07	+0.18	+0.44	−0.42	−2.2	−0.5
	17	Berlin	B. D. +24° 602	I	−0.80	+0.86	−0.02	−0.11	−0.11	−0.03	+0.20	−0.04	−0.47	−3.7	−1.8
	17	Greenwich	η Tauri	I	−0.45	+0.45	+0.15	+0.84	+0.86	+0.25	+0.14	+0.75	−0.24	−2.2	−1.2
	20	Berlin	B. D. +26° 775	I	0.91	+0.75	+0.05	+0.11	+0.12	−0.02	+0.06	+0.18	−0.39	−2.4	−0.5
1897, Jan.	7	Berlin	252 B. Aquarii	I	−0.62	+0.59	+0.13	−0.05	−0.14	−0.11	+0.43	+0.11	−0.78	−3.9	−2.0
	10	Berlin	B. D. +10° 128	I	−0.89	+0.97	−0.05	+0.08	+0.09	+0.03	+0.43	+0.10	−1.00	−4.3	−2.4
	10	Berlin	B. D. +11° 146	I	−0.10	+0.11	+0.50	−0.87	−1.00	−0.42	−0.06	−0.29	−0.11	+0.5	+0.7
	10	Berlin	B. D. +11° [illegible]	I	−0.85	+0.92	+0.16	−0.28	−0.32	−0.12	+0.36	−0.02	−0.95	−3.1	−1.3
	11	Santiago	[illegible] Arietis	I	−0.89	+1.00	+0.02	−0.09	−0.09	−0.04	+0.35	−0.11	−0.98	−1.6	+0.3
	[illegible]	Cape	A Geminor.	I	−0.52	+0.10	+0.77	+0.41	+0.88	−0.27	−0.07	+0.86	−0.04	+1.0	+2.1
	27	Cape	χ Virginis	E	+0.30	+0.25	−0.56	+0.80	−0.96	+0.48	+0.01	+0.16	−0.26	−0.1	−0.6
	27	Cape	σ Scorpii	IB	−0.46	−0.36	−0.34	−0.84	+0.91	−0.19	−0.04	−0.81	+0.37	−1.9	−0.9
	27	Cape	σ Scorpii	E	+0.81	+0.64	−0.25	−0.63	+0.66	+0.08	+0.11	−0.67	−0.64	+2.9	+1.5
Feb.	13	Cape	39 Geminor.	I	−0.70	+0.10	+0.81	+0.50	+0.95	−0.17	−0.04	+0.94	−0.18	−0.7	−0.1
	23	Cape	[illegible] Scorpii	E	[illegible]	+0.89	−0.04	0.08	[illegible]	[illegible]	+0.14	[illegible]	−1.00	−1.0	[illegible]
Apr.	12	Kasan	19 Leonis	I	−1.00	−0.23	−0.24	+0.05	−0.25	−0.07	−0.35	−0.35	−0.55	−1.0	+1.2
	14	Cape	79 Leonis	I	−1.06	−0.65	+0.10	−0.08	+0.14	−0.25	−0.44	+0.07	−0.17	−1.5	+0.8
	19	Cape	σ Scorpii	E	+1.03	+0.89	−0.14	−0.31	+0.35	+0.15	+0.14	−0.37	−0.54	+2.6	+0.7
May	5	Cape	136 Tauri	I	−0.80	+0.61	−0.37	−0.34	−0.50	−0.02	−0.04	−0.44	−0.64	−1.3	+0.5
	11	Santiago	75 Leonis	I	−0.64	−0.36	−0.63	+0.49	−0.80	+0.26	−0.36	−0.11	−0.50	−2.3	−0.9

GROUP XIII—1891-1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	b_0	σ_0	δ_0	ε	P	n	n′
													″	″
1897, July 3	Cape	18 Leonis	I	−0.48	−0.07	+0.85	−0.26	+0.88	−0.41	−0.11	+0.56	−0.35	−0.4	+0.7
12	Cape	λ Sagittarii	I	−0.60	−0.43	+0.70	+0.43	−0.82	−0.18	+0.05	+0.85	−0.18	−0.2	+1.2
13	Greenwich	χ Sagittarii	I	−0.94	−0.55	+0.49	+0.17	−0.52	−0.28	+0.17	+0.55	−0.12	+1.6	+3.8
20	Santiago	η Piscium	IB	−0.89	+0.76	−0.05	+0.21	+0.22	+0.06	+0.40	+0.17	+0.86	−0.6	+1.5
20	Santiago	η Piscium	E	+0.77	−0.66	−0.11	+0.54	+0.55	+0.23	−0.28	+0.17	−0.74	+3.6	+2.1
23	Greenwich	17 Tauri	IB	−0.84	+0.94	−0.13	−0.33	−0.35	−0.08	+0.19	−0.24	+0.85	−1.4	+0.5
23	Greenwich	16 Tauri	IB	−0.13	+0.15	−0.35	−0.92	−0.99	−0.18	+0.01	−0.82	+0.14	+0.6	+0.9
23	Greenwich	16 Tauri	E	+0.29	−0.32	−0.34	−0.88	−0.95	−0.16	−0.09	−0.82	−0.29	+1.1	+0.5
23	Greenwich	23 Tauri	IB	−0.66	+0.73	+0.24	+0.63	+0.68	+0.11	+0.16	+0.62	+0.66	−1.7	−0.2
23	Greenwich	17 Tauri	E	+0.89	−0.98	−0.06	−0.16	−0.17	−0.02	−0.20	−0.22	−0.88	+2.6	+0.9
23	Greenwich	η Tauri	IB	−0.84	+0.93	+0.13	+0.33	+0.36	+0.06	+0.20	+0.37	+0.84	−0.6	+1.4
23	Greenwich	23 Tauri	E	+0.52	−0.57	+0.30	+0.76	+0.82	+0.17	−0.10	+0.66	−0.51	+0.7	−0.3
23	Greenwich	24 Tauri	E	+0.79	−0.87	+0.19	+0.46	+0.49	+0.10	−0.16	+0.36	−0.78	+0.2	−1.3
23	Greenwich	η Tauri	E	+0.74	−0.82	+0.22	+0.53	+0.57	+0.11	−0.15	+0.42	−0.74	+1.6	+0.2
23	Greenwich	28 Tauri	IB	−0.60	+0.67	+0.28	+0.69	+0.74	+0.13	+0.14	+0.68	+0.60	+0.3	+1.7
23	Greenwich	28 Tauri	E	+0.40	−0.45	+0.34	+0.83	+0.89	+0.15	−0.07	+0.73	−0.40	+0.3	−0.5
23	Greenwich	105 B. Tauri	E	+0.90	−1.00	−0.02	−0.04	−0.04	0.00	−0.20	−0.11	−0.90	−1.0	−2.7
Aug. 1	Santiago	359 B. Leonis	I	−1.04	−0.46	−0.03	+0.04	−0.05	−0.13	−0.46	+0.07	+0.99	−4.3	−1.9
4	Greenwich	89 Virginis	I	−0.86	−0.74	+0.05	−0.59	+0.59	−0.35	−0.26	−0.22	−0.80	−0.4	+1.6
4	Cape	83 Virginis	I	−1.06	−0.88	−0.03	+0.26	−0.26	−0.12	−0.37	+0.20	−0.95	−0.1	+2.3
9	Evanston	χ Sagittarii	I	−0.92	−0.56	−0.49	−0.18	+0.52	−0.06	+0.18	−0.43	−0.48	−1.2	+0.9
14	Evanston	λ Piscium	IB	−0.72	+0.31	+0.46	−0.50	−0.68	−0.37	+0.26	+0.11	+0.37	−5.1	−3.4
17	Santiago	ι Arietis	E	+0.90	−0.81	−0.01	+0.18	+0.18	+0.07	−0.35	+0.10	+0.97	+1.1	−0.6
Sept. 9	Cape	ρ Aquarii	I	−0.77	−0.04	−0.56	+0.30	+0.64	+0.17	+0.39	−0.24	−0.28	−2.7	−0.9
18	Cape	136 Tauri	E	+0.28	−0.27	−0.77	−0.56	−0.95	+0.05	+0.01	−0.96	−0.31	+0.9	+0.4
Oct. 1	Cape	A Ophiuchi	I	−1.09	−0.96	−0.14	−0.14	+0.20	−0.23	−0.02	−0.12	−0.88	−0.8	+1.8
3	Evanston	53 Sagittarii	I	−1.04	−0.69	+0.04	−0.01	−0.04	−0.16	+0.24	+0.11	−0.99	−0.7	+1.8
3	Greenwich	48 Sagittarii	I	−0.99	−0.73	−0.32	−0.08	+0.33	−0.08	+0.21	−0.25	−0.94	−1.9	+0.5
3	Greenwich	χ Sagittarii	I	−0.78	−0.58	−0.64	−0.16	+0.66	+0.03	+0.18	−0.57	−0.75	−2.2	−0.3
8	Cape	16 Piscium	I	−0.62	+0.16	+0.49	−0.60	−0.77	−0.38	+0.19	+0.13	−0.32	+0.8	+2.3
30	Evanston	49 Sagittarii	I	−0.71	−0.51	−0.73	−0.16	+0.75	+0.04	+0.16	−0.65	−0.61	−3.1	−1.4
Nov. 4	Cape	κ Piscium	I	−0.97	+0.16	+0.07	−0.08	−0.11	−0.14	+0.42	+0.11	−0.84	−0.8	+1.5
4	Cape	9 Piscium	I	−0.81	+0.13	−0.35	+0.43	+0.56	+0.17	+0.43	0.00	−0.71	−3.0	−1.0
Dec. 2	Kasan	22 Piscium	I	−0.56	+0.11	−0.42	+0.69	+0.81	+0.32	+0.34	0.00	−0.58	−1.5	−0.1
5	Cape	θ Arietis	I	−0.90	+0.21	−0.05	−0.36	−0.30	−0.19	+0.28	−0.14	−0.62	−1.9	+0.3
5	Evanston	26 Arietis	I	−0.42	+0.40	−0.14	−0.87	−0.88	−0.25	+0.10	−0.52	−0.28	−0.5	+0.5
6	Kasan	ε Arietis	I	−0.90	+0.89	−0.02	−0.07	−0.07	−0.03	+0.25	0.00	−0.54	−1.7	+0.5
7	Kasan	27 Tauri	I	−0.48	+0.50	−0.41	−0.74	−0.85	−0.15	+0.07	−0.69	−0.18	−1.0	+0.2
13	Cape	π Cancri	E	+0.91	−0.30	+0.30	−0.09	+0.31	−0.04	+0.38	+0.14	−0.82	+2.8	+0.9
25	Evanston	ο Capricor.	I	−0.03	−0.02	+0.99	−0.11	−1.00	−0.31	−0.05	+0.82	−0.01	+1.4	+1.5
27	Evanston	θ Aquarii	I	−0.42	−0.10	+0.77	−0.51	−0.92	−0.45	+0.08	+0.45	−0.31	+2.1	+3.1
1898, Jan. 2	Kasan	ε Arietis	I	−0.31	+0.32	+0.32	+0.88	+0.94	+0.22	+0.11	+0.70	−0.31	−1.3	−0.5
3	Greenwich	17 Tauri	I	−0.76	+0.82	−0.26	−0.46	−0.53	−0.10	+0.15	−0.39	−0.61	−1.5	+0.4
3	Greenwich	24 Tauni	I	−0.90	+0.96	+0.04	+0.07	+0.08	0.00	+0.19	+0.15	−0.72	−5.2	−2.0
3	Greenwich	23 Tauri	I	−0.78	+0.84	+0.25	+0.42	+0.49	+0.08	+0.17	+0.49	−0.63	−3.4	−1.4
3	Greenwich	17 Tauri	EB	+0.85	−0.90	−0.17	−0.28	−0.33	−0.05	−0.18	−0.36	+0.68	+1.2	−0.6
3	Greenwich	η Tauri	I	−0.89	+0.95	+0.08	+0.13	+0.15	+0.02	+0.18	+0.26	−0.71	−3.2	−1.0
3	Greenwich	23 Tauri	EB	+0.70	−0.75	+0.32	+0.54	+0.63	+0.10	−0.13	+0.46	+0.56	+2.5	+1.0
3	Greenwich	105 B. Tauri	I	−0.74	+0.79	−0.30	−0.49	−0.57	−0.09	+0.13	−0.41	−0.59	−3.7	−1.8
3	Greenwich	28 Tauri	I	−0.84	+0.89	+0.19	+0.32	+0.37	+0.05	+0.17	+0.41	−0.67	−3.2	−1.1
3	Greenwich	27 Tauri	I	−0.64	+0.68	+0.36	+0.60	+0.70	+0.11	+0.14	+0.66	−0.51	−1.2	+0.4
3	Greenwich	η Tauri	EB	+0.87	−0.93	+0.12	+0.20	+0.24	+0.04	−0.17	+0.12	+0.70	+2.3	+0.5
3	Greenwich	27 Tauri	EB	+0.64	−0.69	+0.37	+0.60	+0.70	+0.11	−0.11	+0.53	+0.52	−1.6	−2.0
5	Evanston	125 Tauri	I	−0.75	+0.80	−0.46	−0.32	−0.56	+0.01	−0.02	−0.48	−0.28	−2.5	−0.6
10	Cape	18 Leonis	E	+0.95	−0.25	−0.18	+0.09	−0.20	+0.16	+0.38	−0.19	−0.63	+2.7	+0.7
10	Cape	19 Leonis	E	+0.96	−0.25	+0.11	−0.06	+0.12	+0.03	+0.40	0.00	−0.63	+3.4	+1.4
26	Evanston	45 Piscium	I	−0.58	+0.19	−0.28	+0.76	+0.81	+0.29	+0.33	+0.17	−0.50	−1.6	−0.1
Feb. 5	Evanston	σ^2 Cancri	I	−0.95	+0.48	+0.05	−0.01	+0.05	−0.07	−0.35	+0.12	+0.01	−3.5	−1.1
13	Cape	42 Libræ	E	+0.99	+0.85	+0.23	+0.39	−0.45	+0.27	+0.15	+0.30	−0.89	+1.5	−0.6
25	Cape	θ Arietis	I	−0.84	+0.77	+0.08	+0.37	+0.38	+0.10	+0.31	+0.32	−0.77	−1.9	+0.2
25	Evanston	26 Arietis	I	−0.93	+0.78	0.00	+0.01	+0.01	−0.04	+0.31	+0.08	−0.90	−1.8	+0.5
Mar. 1	Kasan	125 Tauri	I	−0.20	+0.24	−0.84	−0.50	−0.98	+0.02	0.00	−0.95	−0.23	−1.3	−0.8
2	Cape	ε Geminor.	I	−0.86	+0.89	+0.26	+0.07	+0.27	−0.04	−0.13	+0.33	−0.82	−0.3	+1.4
5	Cape	π Cancri	I	−0.82	+0.44	−0.45	+0.17	−0.48	+0.13	−0.35	−0.27	−0.36	−4.4	−2.3
13	Greenwich	σ Scorpii	IB	−1.07	−0.97	−0.07	−0.07	+0.10	−0.17	−0.10	+0.19	+0.97	−1.4	+1.4
13	Greenwich	σ Scorpii	E	+1.04	+0.92	+0.21	+0.22	−0.30	+0.21	+0.10	+0.18	−0.92	+4.8	+2.5
13	Pola	σ Scorpii	IB	−1.05	−0.95	+0.12	+0.13	−0.18	−0.14	−0.10	+0.25	+0.95	−0.8	+1.0
13	Strassburg	σ Scorpii	I	−1.06	−0.95	+0.12	+0.12	−0.17	−0.16	−0.10	+0.25	+0.95	−0.9	+1.8
13	Strassburg	σ Scorpii	E	+1.01	+0.92	+0.24	+0.24	−0.34	+0.19	+0.09	+0.21	−0.91	+4.8	+2.0
13	Prague	σ Scorpii	IB	−1.03	−0.93	+0.21	+0.22	−0.30	−0.14	−0.10	+0.32	+0.93	−1.4	+1.3

GROUP XIII—1891–1908—Continued.

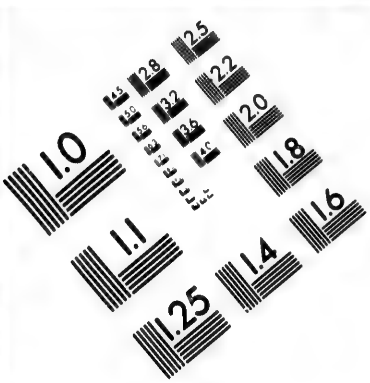
Date.	Place.	Star.	Ph.	λ	κ	iθ	ι	b_0	α_0	δ_0	e	P	n	n'
													″	″
1898, Mar. 13	Prague	α Scorpii	E	+0.98	+0.88	+0.28	+0.29	−0.40	+0.19	+0.09	+0.31	−0.88	+4.9	+2.7
17	Cape	ρ Capricor.	E	+0.80	+0.57	+0.66	−0.11	−0.67	−0.07	−0.27	+0.59	−0.61	+2.2	+0.4
26	Kasan	9 Tauri	I	−0.90	+0.86	+0.11	+0.17	+0.20	+0.02	+0.19	+0.24	−0.75	−0.8	+1.5
Apr. 1	Kasan	54 Cancri	I	−0.75	+0.55	+0.58	−0.17	+0.60	−0.22	−0.39	+0.53	−0.73	−2.6	−0.6
2	Evanston	10 Sextantis	I	−0.85	+0.26	+0.40	−0.26	+0.48	−0.26	−0.32	+0.33	−0.52	−3.2	−1.0
4	Kasan	p^3 Leonis	I	−0.95	0.00	−0.21	+0.29	−0.36	+0.05	−0.45	−0.02	−0.33	−5.0	−2.5
25	Cape	139 Tauri	I	−0.73	+0.57	+0.55	+0.25	+0.60	−0.05	−0.05	+0.66	−0.64	−1.2	+0.7
28	Cape	θ Cancri	I	−0.62	+0.06	+0.76	−0.17	+0.78	−0.28	−0.14	+0.68	−0.63	−1.3	+0.3
29	Greenwich	ξ Leonis	I	−0.32	+0.16	−0.83	+0.45	−0.94	+0.34	−0.20	−0.57	−0.32	−1.5	−0.7
May 2	Greenwich	13 B. Virginis	I	−0.61	−0.09	+0.32	+0.75	+0.81	−0.43	−0.17	+0.08	−0.34	−1.5	+0.1
16	Cape	75 Piscium	E	+0.97	−0.25	0.00	−0.02	−0.02	+0.07	−0.38	−0.10	−0.67	+2.3	+0.1
June 5	Greenwich	λ Sagittarii	E	+1.13	+0.98	+0.18	+0.05	−0.19	+0.22	−0.12	+0.11	−0.31	+5.4	+2.8
6	Cape	50 Sagittarii	E	+1.02	+0.89	−0.35	−0.01	+0.35	+0.26	−0.20	−0.40	−0.47	+2.8	+0.5
13	Cape	105 Piscium	E	+0.83	−0.31	−0.07	−0.50	−0.50	−0.09	−0.22	−0.37	−0.76	+1.5	−0.4
30	Cape	42 Libræ	I	−0.85	+0.67	−0.39	−0.50	+0.63	−0.27	−0.12	−0.46	−0.47	−0.5	+1.8
30	Kasan	λ Sagittarii	I	−1.13	−0.99	−0.10	−0.02	+0.11	−0.23	+0.13	+0.06	−0.52	−1.8	+1.3
Aug. 6	Cape	75 Piscium	E	+0.16	−0.02	+0.13	+0.99	+0.99	+0.38	+0.02	+0.29	−0.14	+1.6	+1.2
25	Cape	26 Ophiuchi	I	−0.36	−0.31	+0.83	+0.47	−0.95	−0.04	−0.03	+0.94	−0.32	+0.4	+1.4
Sept. 3	Cape	η Piscium	E	+0.97	−0.14	+0.02	+0.13	+0.13	+0.12	−0.34	−0.04	−0.59	+2.2	−0.1
23	Cape	ν^1 Sagittarii	I	−1.02	−0.92	−0.39	−0.02	+0.39	−0.13	+0.16	−0.31	−0.90	0.0	+2.8
23	Cape	ν^2 Sagittarii	I	−1.01	−0.91	−0.41	−0.02	+0.41	−0.12	+0.17	−0.32	−0.89	−0.1	+2.7
28	Greenwich	16 Piscium	I	−1.01	−0.37	+0.09	−0.27	−0.28	−0.26	+0.38	+0.05	−0.30	−0.1	+2.7
Oct. 20	Cape	23 Sagittarii	I	−0.69	−0.61	+0.78	+0.09	−0.79	−0.23	+0.06	+0.82	−0.57	−0.7	+1.3
24	Cape	51 Aquarii	I	−1.07	−0.70	+0.04	−0.05	−0.07	−0.20	+0.40	+0.12	−0.88	+0.4	+3.4
Nov. 16	Cape	1 Sagittarii	I	−1.08	−0.93	−0.18	−0.03	+0.18	−0.17	+0.09	−0.10	−0.59	−3.0	−0.8
22	Greenwich	19 Piscium	I	−0.77	−0.36	+0.16	−0.63	−0.65	−0.35	+0.26	+0.11	−0.71	+0.5	+2.7
22	Wilhelmshaven	19 Piscium	I	−0.84	−0.40	+0.13	−0.54	−0.56	−0.01	+0.29	+0.11	−0.78	+1.4	+3.8
22	Kasan	19 Piscium	I	−1.02	−0.48	+0.01	−0.05	−0.05	−0.13	+0.40	+0.08	−0.94	−0.1	+2.8
Dec. 19	Kasan	κ Piscium	I	−1.04	−0.59	+0.01	−0.03	−0.03	−0.15	+0.41	+0.06	−0.97	−2.6	+0.4
23	Kasan	47 Arietis	I	−0.91	+0.30	+0.16	+0.20	+0.26	+0.02	+0.22	+0.25	−0.76	−1.4	+1.2
23	Greenwich	47 Arietis	I	−0.82	+0.27	+0.31	+0.40	+0.51	+0.08	+0.22	+0.43	−0.68	−3.2	−0.8
30	Cape	o^1 Cancri	E	+0.40	−0.42	−0.76	+0.49	−0.90	+0.30	+0.09	−0.70	−0.24	−0.2	−1.2
1899, Jan. 19	Greenwich	μ Arietis	I	−0.82	+0.14	−0.30	−0.41	−0.51	−0.16	+0.21	−0.27	−0.85	−0.7	+1.7
Feb. 2	Cape	43 H. Virginis	E	+0.70	+0.11	−0.35	−0.61	+0.70	−0.14	+0.25	−0.47	−0.71	+1.7	−0.1
4	Cape	27 G. Scorpii	E	+0.90	+0.49	−0.44	−0.29	+0.53	+0.06	+0.11	−0.54	−0.77	+2.6	+0.3
18	Kasan	103 Tauri	I	−0.54	+0.40	−0.77	−0.26	−0.81	−0.02	+0.01	−0.74	−0.57	−1.0	+0.6
19	Kasan	1 Geminor.	I	−0.77	+0.71	+0.52	+0.06	+0.53	−0.04	−0.07	+0.60	−0.76	−5.3	−3.0
21	Cape	79 Geminor.	I	−0.89	+0.99	+0.11	−0.03	+0.11	−0.02	−0.24	+0.19	−0.61	−3.1	−0.5
22	Greenwich	90 B. Cancri	I	−0.81	+0.89	+0.38	−0.22	+0.44	−0.13	−0.26	+0.44	−0.40	−2.[illegible]	+0.4
Mar. 16	Cape	26 Tauri	I	−0.97	+0.45	−0.04	−0.03	−0.05	−0.06	+0.15	+0.06	−0.84	−3.[illegible]	−0.3
16	Cape	27 Tauri	I	−0.46	+0.22	−0.72	−0.51	−0.88	−0.15	+0.06	−0.70	−0.40	−0.8	−0.6
20	Kasan	56 Geminor.	I	−0.81	+0.86	−0.42	+0.10	−0.43	+0.09	−0.21	−0.34	−0.86	−4.1	−1.7
Apr. 15	Wilhelmshaven	η Geminor.	I	−0.09	+0.07	+1.00	+0.01	+1.00	−0.01	0.00	+1.00	−0.08	−0.8	−5.8
17	Wilhelmshaven	3 Cancri	I	−0.50	+0.55	+0.75	−0.35	+0.83	+0.03	−0.12	+0.80	−0.56	−2.8	−1.3
17	Greenwich	3 Cancri	I	−0.21	+0.24	+0.88	−0.41	+0.97	−0.24	−0.03	+0.88	−0.24	−0.1	+0.6
19	Wilhelmshaven	h Leonis	I	−0.80	+0.84	+0.31	−0.35	+0.47	+0.06	0.30	+0.38	−0.80	−3.4	−1.0
19	Kasan	h Leonis	I	−0.90	+0.95	−0.10	+0.11	−0.14	+0.05	0.30	−0.01	−0.80	−5.0	−2.3
28	Pola	θ Ophiuchi	IB	−1.06	−0.73	+0.03	+0.01	−0.03	−0.15	+0.02	+0.11	+0.73	[illegible]4	+0.8
28	Pola	θ Ophiuchi	E	+1.05	+0.72	+0.12	+0.03	−0.12	+0.15	−0.01	+0.02	−0.72	[illegible]	+1.4
May 1	Cape	31 B. Capricor.	E	+1.06	+0.98	+0.16	−0.10	−0.19	+0.11	−0.31	+0.07	−0.97	−[illegible]1	−3.3
3	Cape	44 Aquarii	E	+1.03	+0.87	+0.14	−0.24	−0.28	+0.04	−0.40	+0.05	−0.90	+3.5	+0.7
12	Cape	132 Tauri	I	−0.66	+0.52	−0.71	−0.06	−0.71	+0.02	−0.05	−0.64	−0.38	−2.1	−0.1
26	Greenwich	9 Sagittarii	E	+1.08	+0.77	+0.22	0.00	−0.22	+0.17	−0.08	+0.12	−0.45	+0.1	−2.8
June 13	Cape	o Leonis	I	−0.59	+0.64	−0.45	+0.61	−0.76	+0.29	−0.30	−0.42	−0.58	−5.7	−3.9
25	Cape	τ Capricor.	E	+1.11	+0.98	−0.11	+0.09	+0.14	+0.26	−0.31	−0.22	−0.50	+2.2	−0.9
July 18	Cape	δ Scorpii	I	−0.06	−0.02	+0.90	+0.44	−1.00	+0.11	−0.02	+0.87	−0.04	+1.5	+1.7
18	Cape	δ Scorpii	EB	+0.28	+0.08	+0.87	+0.42	−0.96	+0.14	+0.03	+0.80	+0.20	+1.9	+1.1
20	Kasan	7 Sagittarii	I	−1.04	−0.68	+0.39	−0.01	−0.39	−0.23	+0.08	+0.47	−0.38	−1.0	+2.2
Aug. 26	Cape	66 Arietis	E	+0.56	−0.04	−0.70	−0.43	−0.82	−0.10	−0.11	−0.71	−0.54	+2.3	+0.7
27	Cape	62 Tauri	E	+0.89	−0.27	−0.36	−0.12	−0.38	+0.01	−0.08	−0.45	−0.91	+2.9	+0.4
Oct. 11	Cape	36 Sagittarii	I	−1.03	−0.72	+0.17	−0.06	−0.18	−0.16	+0.17	+0.28	−0.98	−0.4	+2.9
12	Kasan	57 Sagittarii	I	−1.04	+0.87	−0.18	+0.11	+0.21	−0.09	+0.23	−0.12	−0.97	+0.7	+4.0
27	Cape	o Leonis	E	+0.90	−1.00	+0.01	−0.01	+0.01	−0.02	+0.36	−0.06	−0.98	+4.8	+2.1
Nov. 11	Cape	187 B. Aquarii	I	−1.01	−0.92	+0.09	−0.35	−0.36	−0.29	+0.34	+0.25	−0.88	−0.5	+2.8
13	Cape	36 Piscium	I	−0.98	−0.72	−0.10	−0.42	−0.43	−0.31	+0.31	+0.05	−0.68	−0.1	+3.1
14	Cape	75 Piscium	I	−0.41	−0.24	−0.42	−0.83	−0.93	−0.38	+0.07	−0.25	−0.24	+2.4	+3.7
18	Cape	99 Tauri	E	+0.99	+0.25	−0.11	−0.01	−0.11	+0.07	−0.03	−0.19	−0.20	+3.9	+0.9
Dec. 8	Cape	138 B. Aquarii	I	−0.67	−0.62	+0.24	−0.75	−0.79	−0.40	+0.18	+0.43	−0.60	+0.6	+2.3
13	Cape	μ Arietis	I	−0.98	−0.32	−0.24	−0.18	−0.30	−0.17	+0.22	−0.10	−0.68	−1.1	+2.1
16	Greenwich	175 H^1. Tauri	I	−0.88	+0.26	−0.44	+0.04	−0.44	−0.02	−0.04	−0.36	−0.04	−2.7	+0.2

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	b_0	α_0	δ_0	s	P	n	n′
1899, Dec. 16	Greenwich	175 H^1. Tauri	E	+0.81	−0.24	−0.56	+0.05	−0.56	+0.07	+0.04	−0.62	+0.03	−0.5	−3.0
1900, Jan. 9	Greenwich	27 Arietis	I	−0.51	−0.24	+0.69	+0.55	+0.88	+0.16	+0.14	+0.58	−0.46	−3.0	−1.3
11	Wilhelmshaven	67 Tauri	I	−0.71	−0.05	+0.67	+0.14	+0.69	−0.05	+0.07	+0.68	−0.54	−4.7	−2.4
23	Cape	40 H. Virginis	E	+0.57	−0.32	+0.58	+0.55	−0.80	+0.23	+0.14	+0.41	−0.59	+2.3	+0.5
Feb. 3	Cape	*d* Piscium	I	−0.68	−0.54	+0.26	+0.74	+0.79	+0.18	+0.29	+0.13	−0.46	−1.8	+0.4
6	Wilhelmshaven	δ Arietis	I	−0.81	−0.34	+0.54	+0.28	+0.60	−0.06	+0.16	+0.51	−0.80	−2.3	+0.4
6	Greenwich	δ Arietis	I	−0.73	−0.27	+0.66	+0.34	+0.74	+0.07	+0.14	+0.60	−0.68	−1.9	+0.5
7	Greenwich	39 Tauri	I	−0.76	−0.13	−0.69	−0.18	−0.71	−0.13	+0.07	−0.56	−0.70	−2.3	+0.2
12	Cape	90 B. Cancri	I	−0.91	+0.84	+0.01	−0.01	+0.01	+0.01	−0.30	+0.10	−0.33	−4.7	+1.7
Mar. 5	Wilhelmshaven	40 Arietis	I	−0.82	−0.43	+0.55	+0.34	+0.64	−0.09	+0.19	+0.48	−0.62	−3.0	−0.3
7	Cape	300 B. Tauri	I	−0.58	0.00	−0.81	−0.05	−0.81	−0.08	+0.03	−0.72	−0.57	−1.8	+0.1
8	Cape	394 B. Tauri	I	−0.95	+0.23	+0.18	−0.03	+0.18	−0.05	−0.05	+0.27	−0.98	−4.9	−1.7
23	Cape	14 Sagittarii	E	+0.97	+0.30	−0.30	+0.09	+0.31	+0.12	+0.09	−0.39	−0.93	+2.2	−0.9
26	Cape	ν Aquarii	E	+1.00	+0.78	+0.22	−0.38	−0.44	+0.02	−0.31	+0.23	−0.64	+3.3	+0.1
Apr. 2	Cape	τ Arietis	I	−1.05	−0.36	−0.21	−0.08	−0.22	−0.19	+0.17	−0.08	−0.57	−2.9	+0.6
4	Greenwich	*o* Tauri	I	−1.02	+0.03	−0.34	+0.04	−0.34	−0.07	−0.02	−0.25	−0.84	−4.1	−0.7
5	Cape	η Geminor.	I	−0.96	+0.29	−0.18	+0.06	−0.19	−0.04	−0.10	−0.10	−0.92	−5.1	−1.8
May 1	Wilhelmshaven	ι Tauri	I	−1.02	−0.14	+0.20	−0.07	+0.20	−0.11	+0.02	+0.26	−0.50	−5.4	−1.9
7	Greenwich	19 Sextantis	I	−0.86	+0.91	+0.05	−0.28	+0.28	+0.07	−0.33	+0.23	−0.93	−5.4	−2.5
16	Cape	52 Ophiuchi	E	+0.94	+0.07	+0.34	−0.07	−0.35	+0.06	−0.04	−0.28	−0.56	+2.3	−0.8
16	Cape	158 G. Ophiuchi	E	+0.73	+0.08	+0.67	−0.16	−0.69	+0.03	−0.04	−0.27	−0.54	+5.1	+2.7
16	Cape	58 Ophiuchi	E	+0.99	+0.06	−0.19	+0.04	+0.19	+0.09	−0.04	+0.62	−0.41	+3.9	+0.6
20	Cape	19 Aquarii	E	+1.04	+0.84	+0.09	−0.20	−0.22	+0.06	−0.35	+0.05	−0.93	+3.1	−0.3
June 2	Greenwich	κ Cancri	I	−0.92	+0.07	+0.10	−0.20	+0.22	+0.06	−0.30	+0.18	+0.24	−5.0	−1.8
8	Cape	550 B. Virginis	I	−0.53	+0.48	+0.57	+0.59	−0.82	+0.25	−0.22	+0.39	−0.42	−1.9	0.0
14	Cape	45 Sagittarii	E	+0.81	+0.34	+0.50	−0.40	−0.64	−0.03	−0.17	+0.55	−0.39	+2.9	+0.2
July 6	Cape	40 H. Virginis	I	−0.90	+0.75	−0.18	−0.12	+0.22	−0.05	−0.25	−0.05	−0.89	−4.3	−1.0
10	Cape	58 Ophiuchi	I	−0.98	+0.03	+0.30	−0.08	−0.31	−0.11	+0.03	+0.39	−0.31	−2.6	+0.8
11	Greenwich	ξ Sagittarii	I	−0.98	−0.31	−0.42	+0.28	+0.50	−0.04	+0.14	−0.42	−0.05	−3.5	[illegible]
Aug. 7	Cape	μ Sagittarii	I	−1.04	−0.04	+0.01	−0.01	−0.01	−0.12	+0.09	+0.10	−0.62	−4.1	[illegible]
8	Cape	*d* Sagittarii	I	−1.00	−0.28	−0.28	+0.22	+0.35	−0.07	+0.18	−0.27	−0.40	−2.8	+0.7
17	Cape	*A* Tauri	E	+0.64	+0.30	−0.78	−0.08	−0.78	−0.02	−0.08	−0.74	−0.62	+3.3	−1.2
Sept. 1	Cape	ω^2 Scorpii	I	−0.80	+0.41	+0.53	+0.03	−0.53	+0.04	−0.10	+0.53	−0.85	−1.3	+1.5
2	Cape	116 B. Ophiuchi	I	−0.96	+0.25	+0.14	−0.03	−0.14	−0.04	−0.07	+0.22	−0.96	−2.7	+0.7
4	Cape	171 B. Sagittarii	I	−0.55	−0.11	−0.67	+0.52	+0.85	+0.07	+0.11	−0.77	−0.41	−3.6	−1.7
4	Greenwich	36 Sagittarii	I	−1.04	−0.31	−0.26	−0.19	−0.32	−0.15	+0.14	+0.38	−0.74	−4.9	−1.3
4	Greenwich	36 Sagittarii	EB	+1.08	+0.33	+0.14	−0.10	−0.17	[illegible]	−0.15	+0.09	+0.77	+4.8	[illegible]
12	Greenwich	π Arietis	IB	−1.15	−0.83	+0.03	+0.02	+0.04	−0.16	+0.22	+0.10	+0.71	−5.7	−1.7
12	Evanston	44 Arietis	E	+1.07	+0.75	−0.23	−0.09	−0.25	+0.12	−0.21	−0.26	−0.74	+6.1	+2.5
13	Greenwich	13 Tauri	IB	−1.05	−0.63	−0.37	−0.06	−0.38	−0.18	+0.13	−0.24	−0.85	−2.6	+1.1
13	Greenwich	14 Tauri	IB	−1.13	−0.68	+0.03	0.00	+0.03	−0.14	+0.14	+0.07	−0.90	−5.5	−1.5
28	Cape	λ Libræ	I	−0.80	+0.49	+0.51	+0.05	−0.51	+0.06	−0.11	+0.50	−0.72	−0.4	+2.4
Oct. 3	Greenwich	27 G. Capricor.	I	−1.08	−0.62	+0.09	−0.16	−0.18	−0.18	+0.26	+0.18	−0.84	−2.1	+1.7
Nov. 13	Cape	*h* Leonis	E	+0.36	−0.26	+0.19	−0.90	+0.92	−0.30	+0.18	+0.53	−0.39	+3.0	+1.8
26	Cape	*g* Sagittarii	I	−0.97	−0.27	+0.16	−0.23	−0.28	−0.14	+0.22	+0.51	−0.81	+1.1	+4.6
Dec. 5	Cape	67 Tauri	I	−0.89	+0.47	−0.59	+0.05	0.59	−0.18	+0.06	−0.48	−0.15	−3.6	−0.3
9	Cape	23 H^1. Cancri	E	+0.93	−0.31	+0.17	−0.29	+0.34	−0.03	+0.26	+0.22	−0.58	+2.2	−1.0
1901, Jan. 28	Cape	22 H^1. Tauri	I	−0.88	−0.65	−0.55	−0.01	−0.55	−0.17	+0.11	−0.37	−0.81	−3.2	+0.1
30	Pola	ζ Tauri	I	−0.21	−0.10	−0.03	−0.98	−0.98	0.00	−0.01	−0.96	−0.15	−1.1	−0.3
30	Pola	ζ Tauri	EB	+0.28	+0.14	−0.04	−0.96	−0.96	+0.06	+0.01	−0.93	+0.22	−0.7	−1.2
Feb. 15	Cape	ρ Sagittarii	E	+1.02	−0.04	+0.08	−0.09	−0.12	+0.07	−0.18	+0.05	−0.52	+4.7	+1.1
21	Pola	51 Piscium	I	−1.00	−0.88	−0.43	+0.15	+0.46	−0.02	+0.32	+0.13	−0.56	−3.3	+0.4
25	Cape	247 B. Tauri	I	−0.96	−0.63	−0.39	+0.07	−0.40	−0.13	+0.06	−0.29	−0.92	−4.1	−0.5
26	Cape	*o* Tauri	I	−0.88	−0.43	−0.46	+0.21	−0.51	−0.07	−0.01	−0.49	−0.84	−3.7	−0.4
Mar. 10	Cape	28 Libræ	E	+0.84	−0.81	+0.38	+0.04	−0.38	+0.04	+0.16	+0.22	−0.85	+5.2	+2.2
25	Cape	105 Tauri	I	−0.98	−0.56	−0.36	+0.14	−0.38	−0.12	+0.02	−0.30	−0.86	−3.6	+0.1
26	Greenwich	68 Orionis	I	−0.94	−0.41	−0.41	+0.30	−0.51	−0.04	−0.07	−0.45	−0.85	−3.6	0.0
28	Cape	5 Cancri	I	−0.76	+0.05	−0.29	+0.56	−0.63	+0.11	−0.20	−0.51	−0.75	−3.0	−0.1
Apr. 4	Cape	α Virginis	IB	−0.84	+0.93	−0.30	−0.19	+0.35	−0.07	−0.26	−0.08	+0.15	−3.0	+0.2
4	Cape	α Virginis	E	+0.89	−0.99	−0.13	−0.08	+0.15	−0.08	+0.31	−0.11	−0.16	+3.1	−0.1
7	Cape	56 B. Scorpii	E	+0.90	−0.79	−0.11	+0.02	+0.11	−0.04	+0.11	−0.17	−0.75	+3.3	+0.1
7	Cape	β Scorpii	E	+0.90	−0.79	−0.13	+0.02	+0.13	−0.04	+0.09	−0.17	−0.75	+2.9	−0.4
10	Cape	89 G. Sagittarii	E	+0.62	−0.19	−0.55	+0.53	+0.76	+0.11	−0.08	−0.82	−0.65	+1.2	−1.0
22	Greenwich	B. D. +19° 1110	I	−1.01	−0.53	−0.39	+0.25	−0.46	−0.10	−0.04	−0.44	−0.69	−3.0	+0.8
22	Greenwich	57 Orionis	I	−1.07	−0.56	−0.31	+0.21	−0.37	−0.12	−0.05	−0.34	−0.73	−3.6	+0.5
24	Cape	*f* Gem	I	−0.83	−0.07	−0.29	+0.48	−0.56	+0.05	−0.18	−0.46	−0.78	−2.9	+0.3
28	Greenwich	p^3 Leonis	I	−0.97	+0.67	+0.09	+0.21	−0.23	+0.10	−0.35	+0.01	−0.80	−3.5	+0.2
May 5	Cape	123 B. Scorpii	E	+0.89	−0.71	−0.26	+0.08	+0.28	−0.02	+0.05	−0.33	−0.40	+3.7	+0.5
31	Greenwich	11 H. Libræ	I	−0.56	+0.53	+0.81	−0.04	−0.81	+0.14	−0.10	+0.70	−0.13	−1.0	+1.1
June 4	Greenwich	171 B. Sagittarii	E	+0.65	−0.15	+0.47	−0.61	−0.77	−0.10	−0.10	+0.71	−0.38	+3.3	+0.9

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	σ_0	δ_0	ϵ	P	n	n'
													″	″
1901, June 5	Cape	g Sagittarii	E	+0.98	−0.08	+0.02	−0.04	−0.05	+0.04	−0.19	−0.04	−0.76	+4.8	+1.2
12	Cape	19 Arietis	E	+0.81	+0.72	+0.66	+0.20	+0.69	+0.31	−0.17	+0.35	−0.51	+3.6	+0.6
22	Cape	ρ³ Leonis	I	−0.31	+0.23	−0.44	−0.83	+0.94	−0.33	−0.06	+0.23	−0.31	−0.5	+0.7
25	Cape	α Virginis	I	−0.88	+0.86	−0.40	−0.22	+0.46	−0.11	−0.25	−0.14	−0.85	−2.8	+0.3
25	Cape	α Virginis	EB	+0.89	−0.96	−0.16	−0.09	+0.18	−0.09	+0.30	−0.11	+0.94	+2.1	−1.2
29	Greenwich	74 B. Ophiuchi	I	−1.01	+0.74	−0.07	+0.03	+0.08	−0.02	−0.04	+0.01	−0.35	−5.0	−1.1
July 10	Cape	ρ Arietis	E	+1.07	+0.97	−0.18	−0.01	−0.18	+0.12	−0.21	−0.20	−0.86	+2.6	−1.4
25	Pola	κ Libræ	I	−0.14	+0.15	−0.26	+0.95	−0.99	+0.14	−0.03	+0.80	−0.14	0.0	+0.5
28	Greenwich	21 Sagittarii	I	−0.93	+0.42	+0.20	−0.20	−0.41	−0.06	+0.08	+0.47	−0.45	−3.5	+0.1
Aug. 9	Cape	ζ Tauri	E	+1.03	+0.71	−0.20	+0.14	−0.24	+0.12	+0.02	−0.31	−0.82	+3.3	−0.5
19	Cape	86 Virginis	I	−0.85	+0.91	+0.33	+0.12	−0.35	+0.13	−0.28	+0.22	−0.81	−2.8	+0.5
22	Cape	ν Scorpii	I	−0.91	+0.92	+0.02	−0.01	−0.02	+0.03	−0.07	+0.08	−0.99	−4.5	−1.0
24	Greenwich	24 B. Sagittarii	I	−0.75	+0.44	+0.49	−0.44	−0.66	−0.04	+0.04	+0.71	−0.63	−4.2	−1.3
30	Cape	κ Piscium	E	+0.99	+0.57	+0.24	+0.36	+0.43	+0.29	−0.27	−0.12	−0.23	+4.3	+0.6
Sept. 25	Cape	30 Aquarii	I	−0.76	−0.17	+0.15	+0.68	+0.70	+0.14	+0.27	−0.31	−0.35	−3.0	0.0
Oct. 17	Wilhelmshaven	ξ Ophiuchi	I	−0.41	+0.38	−0.73	+0.52	+0.89	+0.03	−0.01	−0.84	−0.39	−3.3	−1.7
19	Evanston	ρ Sagittarii	I	−0.85	+0.31	+0.20	−0.40	−0.45	−0.08	+0.14	+0.48	−0.90	−2.4	+1.0
21	Cape	16 B. Aquarii	I	−0.82	+0.82	−0.03	+0.56	+0.56	+0.11	+0.25	−0.36	−0.80	−3.5	−0.1
23	Greenwich	κ Aquarii	I	−1.06	−0.48	−0.07	−0.15	−0.16	−0.18	+0.32	+0.11	−0.70	−5.1	−0.9
24	Evanston	λ Piscium	I	−0.68	−0.44	−0.48	−0.62	−0.78	−0.36	+0.17	+0.11	−0.32	−3.3	−0.6
27	Greenwich	29 Arietis	IB	−0.84	−0.68	−0.72	−0.06	−0.72	−0.32	+0.13	−0.42	+0.03	−4.8	−1.5
27	Greenwich	29 Arietis	E	+0.95	+0.77	−0.61	−0.04	−0.62	+0.04	−0.19	−0.44	−0.04	+1.8	−1.8
29	Cape	129 H¹. Tauri	E	+1.08	+0.88	[illegible]	+0.14	−0.33	+0.17	−0.07	−0.36	−0.44	+6.5	+2.4
Nov. 16	Cape	283 B. Sagittarii	I	−0.53	+0.25	+0.26	−0.78	−0.82	−0.15	+0.10	+0.80	−0.51	−0.4	+1.7
Dec. 18	Greenwich	λ Piscium	I	−0.53	−0.33	−0.60	−0.61	−0.86	−0.33	+0.12	+0.10	−0.51	−1.0	+1.1
18	Greenwich	λ Piscium	EB	+0.70	+0.43	−0.52	−0.52	−0.73	−0.19	−0.27	+0.05	+0.67	+1.9	−0.8
18	Cape	19 Piscium	I	−1.01	+0.53	−0.17	−0.16	−0.23	−0.17	+0.32	+0.09	−0.96	−1.6	+2.5
19	Evanston	62 Piscium	I	−0.94	−0.74	+0.42	+0.24	+0.48	+0.03	+0.31	+0.16	−0.83	−1.7	+2.1
21	Evanston	ο Arietis	I	−0.86	−0.76	+0.64	−0.01	+0.64	0.00	+0.19	+0.47	−0.52	−2.0	+1.6
22	Cape	175 B. Arietis	I	−0.97	−0.86	−0.50	+0.10	−0.51	−0.25	+0.14	−0.34	−0.52	−1.9	+2.1
1902, Jan. 18	Cape	53 Arietis	I	−0.79	−0.72	−0.67	+0.10	−0.68	−0.23	+0.13	−0.45	−0.67	−2.0	+1.2
19	Cape	43 Tauri	I	−0.40	−0.36	+0.86	−0.37	+0.93	+0.04	+0.04	+0.86	−0.29	−2.7	−1.1
31	Cape	ν Libræ	E	+0.90	−0.97	+0.12	−0.02	−0.12	−0.01	+0.19	+0.04	−0.98	+6.9	+3.4
Feb. 12	Wilhelmshaven	ε Piscium	I	−0.78	−0.56	+0.63	+0.25	+0.67	−0.05	+0.26	+0.21	−0.62	−1.4	+1.8
12	Greenwich	ε Piscium	I	−0.67	−0.47	+0.73	+0.28	+0.78	+0.16	+0.23	+0.24	−0.53	−3.4	−0.7
12	Greenwich	ε Piscium	EB	+0.50	+0.35	+0.75	+0.45	+0.88	+0.16	−0.06	+0.20	+0.39	+1.0	−1.0
[illegible]	Greenwich	26 B. Arietis	I	−1.07	−0.89	−0.21	−0.03	−0.21	−0.17	+0.25	−0.06	−0.93	−4.5	−0.1
[illegible]	Wilhelmshaven	σ Arietis	I	−0.84	−0.76	+0.62	−0.06	+0.62	−0.07	+0.18	+0.45	−0.78	−3.1	+0.3
15	Greenwich	163 B. Tauri	I	−0.57	−0.51	−0.79	+0.34	−0.86	−0.17	+0.05	−0.72	−0.30	−2.1	+0.2
16	Greenwich	i Tauri	I	−0.85	−0.74	+0.55	−0.37	+0.66	−0.07	+0.04	+0.68	−0.72	−2.0	+1.5
16	Wilhelmshaven	i Tauri	I	−0.87	−0.79	+0.49	−0.33	+0.59	−0.10	+0.04	+0.59	−0.78	−4.8	−1.2
17	Cape	χ¹ Orionis	I	−1.06	−0.88	+0.11	−0.13	+0.17	−0.14	−0.04	+0.22	−0.87	−4.1	+0.3
Mar. 17	Greenwich	26 Geminor.	I	−0.86	−0.64	+0.29	−0.57	+0.64	−0.16	−0.07	+0.67	−0.74	−4.4	−0.9
20	Greenwich	ω Leo. (1st)	I	−1.03	−0.31	+0.03	+0.01	−0.02	−0.07	−0.28	+0.05	−0.65	−4.2	0.0
20	Greenwich	ω Leo. (2d.)	I	−1.03	−0.31	0.00	+0.01	−0.02	−0.07	−0.28	+0.05	−0.65	−4.1	+0.1
20	Cape	h Leonis	I	−0.95	+0.21	−0.09	−0.35	+0.36	−0.17	−0.26	+0.15	−0.60	−3.9	0.0
25	Cape	h Virginis	E	+0.90	−0.72	−0.29	−0.06	+0.30	−0.08	+0.29	0.00	−0.29	+4.5	+0.9
28	Cape	73 B. Scorpii	E	+0.87	−0.96	−0.24	+0.12	+0.27	−0.07	+0.11	−0.30	−0.82	+3.7	+0.2
29	Cape	29 Ophiuchi	E	+0.34	−0.37	+0.72	−0.59	−0.93	+0.02	+0.01	+0.87	−0.35	+3.1	+1.8
Apr. 21	Wilhelmshaven	α Virginis	I	−0.50	+0.57	−0.50	−0.11	+0.51	+0.04	−0.22	−0.14	−0.15	−4.3	−0.9
May 10	Cape	57 Orionis	I	−0.93	−0.78	+0.33	−0.46	+0.57	−0.17	−0.03	+0.62	−0.49	−5.8	−1.9
11	Berlin	41 H¹. Geminor.	I	−0.17	−0.13	+0.33	−0.93	+0.99	−0.15	−0.01	+0.96	−0.13	−0.2	+0.9
11	Berlin	B. D. +16° 1373	I	[illegible]	−0.81	+0.16	−0.38	+0.40	−0.19	−0.10	+0.42	−0.83	−4.0	+0.3
11	Berlin	B. D. +17° 1488	I	−0.81	−0.63	−0.19	+0.63	−0.67	−0.03	−0.09	[illegible]	−0.65	−3.6	−0.2
11	Berlin	B. D. +16° 1380	I	−1.05	−0.83	+0.13	−0.29	+0.30	−0.18	−0.10	+0.33	−0.86	−4.6	−0.1
11	Berlin	B. D. +16° 1385	I	−1.07	−0.85	+0.11	−0.23	+0.24	−0.18	−0.10	+0.25	−0.88	−4.6	0.0
12	Cape	1 Cancri	I	−0.35	−0.22	+0.10	−0.04	+0.94	−0.22	−0.05	+0.87	−0.29	−1.4	0.0
12	Greenwich	12 Cancri	I	−0.21	−0.15	+0.05	[illegible]	+0.98	−0.23	−0.02	+0.84	−0.17	−2.2	−1.3
14	Berlin	B. D. + 7° 2203	I	−0.63	−0.22	+0.35	[illegible]	−0.83	+0.18	−0.25	−0.41	−0.71	−3.2	−0.5
15	Berlin	36 Sextantis	I	−0.98	−0.13	+0.18	+0.21	[illegible]	+0.01	−0.38	−0.03	−1.11	−3.6	+0.6
17	Berlin	B. D. − 5° 3487	I	−0.95	+0.33	+0.16	+0.09	−0.20	+0.03	−0.39	+0.07	−0.93	−4.0	+0.1
18	Berlin	B. D. − 9° 3640	I	−0.81	+0.46	−0.43	−0.11	+0.43	−0.14	−0.32	−0.12	−0.68	−4.6	−1.1
19	Berlin	B. D. −12° 3933	I	−0.92	+0.72	−0.05	0.00	[illegible]	+0.02	−0.36	+0.05	−0.61	−4.1	−0.1
25	Berlin	B. D. −18° 5155	E	+0.68	−0.61	+0.19	−0.60	[illegible]	−0.10	+0.07	+0.60	−0.46	+3.0	+0.3
June 10	Cape	η Leonis	I	−0.90	+0.32	−0.17	−0.49	[illegible]	−0.24	−0.23	+0.23	−0.71	−4.4	−0.5
15	Berlin	86 Virginis	I	−0.93	+0.61	+0.04	+0.01	−0.08	+0.01	−0.36	+0.04	−0.93	−4.1	−0.1
17	Cape	32 Libræ	I	−0.85	+0.88	+0.32	[illegible]	−0.35	0.00	−0.16	+0.32	−0.55	−2.8	+0.9
18	Berlin	B. D. −19° 4332	I	−0.88	+0.95	−0.14	[illegible]	−0.15	[illegible]	−0.19	−0.15	−0.43	−4.2	−0.4
18	Berlin	ν Scorpii	I	−0.87	+0.94	−0.17	[illegible]	+0.18	[illegible]	−0.19	−0.18	−0.42	−5.1	−1.4
18	Wilhelmshaven	ν Scorpii	I	−0.87	+0.94	−0.23	+0.14	+0.26	+0.06	−0.11	−0.18	−0.42	−4.8	−1.1



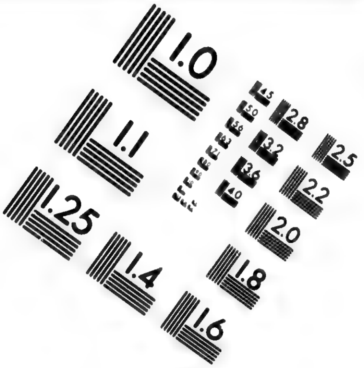
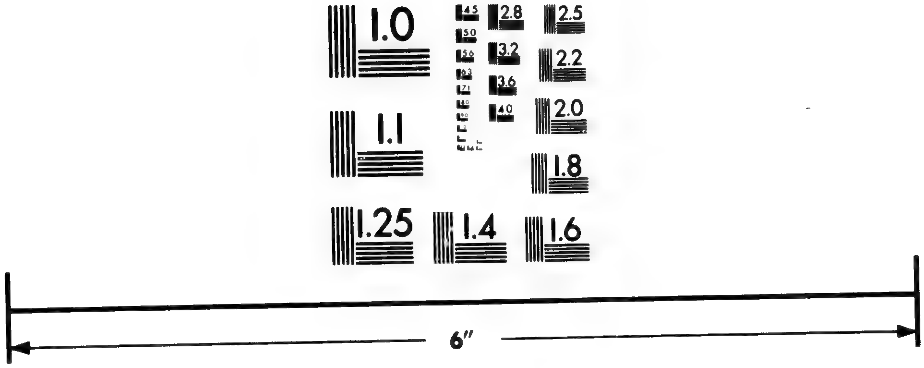
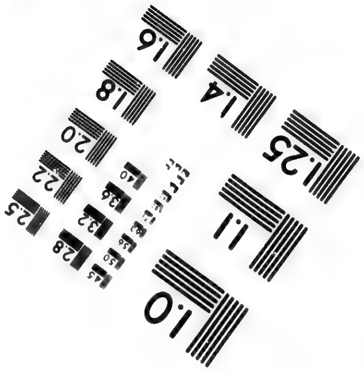


IMAGE EVALUATION
TEST TARGET (MT-3)





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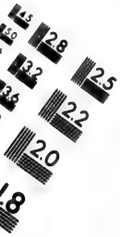
4.5
5.0
2.8
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2.2
2.0
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1.1
1.0

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1902, June 18	Greenwich	ν Scorpii	I	−0.87	+0.90	−0.32	+0.19	+0.38	+0.01	−0.10	−0.27	−0.40	−3.3	+0.4
23	Berlin	B. D. −15° 5663	E	+0.83	−0.52	−0.02	+0.45	+0.45	+0.09	−0.20	−0.43	−0.58	+3.9	+0.6
25	Berlin	B. D. − 8° 5791	E	+0.74	−0.13	−0.34	−0.62	−0.70	−0.18	−0.30	+0.30	−0.76	+3.2	+0.2
27	Berlin	B. D. − 0° 4547	E	+0.99	+0.27	−0.23	−0.18	−0.30	0.00	−0.41	−0.03	−1.17	+4.3	+0.3
28	Berlin	116 B. Piscium	E	+0.31	+0.14	−0.88	−0.39	−0.97	−0.27	−0.16	−0.13	−0.36	+0.5	−0.8
28	Berlin	B. D. + 3° 56	E	+1.04	+0.48	−0.11	−0.06	−0.15	+0.08	−0.40	−0.06	−1.21	+3.9	−0.3
28	Berlin	B. D. + 4° 66	E	+1.00	+0.46	−0.31	−0.14	−0.37	+0.01	−0.40	−0.09	−1.16	+2.8	−1.2
28	Berlin	B. D. + 4° 73	E	+1.04	+0.49	−0.02	−0.02	−0.05	+0.12	−0.39	−0.04	−1.21	+3.4	−0.8
July 11	Cape	261 B. Virginis	I	−0.84	+0.35	−0.46	−0.17	+0.49	−0.17	−0.25	−0.04	−0.84	−4.1	−0.5
11	Cape	f Virginis	I	−0.83	+0.34	−0.47	−0.18	+0.50	−0.17	−0.25	−0.04	−0.83	−3.4	+0.2
15	Berlin	B. D. −18° 4196	I	−0.90	+0.93	+0.80	−0.06	−0.11	+0.05	−0.21	+0.09	−0.78	−4.7	−0.8
18	Cape	100 B. Sagittarii	I	−0.90	+0.94	−0.04	+0.10	+0.10	+0.05	+0.08	−0.05	−0.31	−5.5	−1.6
19	Wilhelmshaven	ρ Sagittarii	I	−0.59	+0.54	+0.16	−0.75	−0.76	−0.09	+0.10	+0.79	−0.07	−5.6	−3.1
19	Berlin	ρ Sagittarii	I	−0.66	+0.60	+0.14	−0.68	−0.70	+0.02	+0.10	+0.69	−0.07	−1.5	+1.3
21	Berlin	8 Aquarii	E	+0.60	+0.32	+0.17	+0.76	+0.77	−0.28	+0.13	−0.60	+0.20	−0.3	−2.7
21	Berlin	B. D. −13° 5830	E	+0.76	−0.40	−0.18	−0.60	−0.62	−0.15	−0.26	+0.39	−0.36	+3.5	+0.4
22	Berlin	B. D. − 9° 5854	E	+0.82	−0.25	−0.27	−0.52	−0.57	−0.14	−0.31	+0.27	−0.56	+4.4	+1.1
28	Berlin	B. D. +14° 502	E	+0.42	+0.33	−0.91	+0.27	−0.96	−0.12	−0.12	−0.67	−0.48	+2.3	+0.6
Oct. 10	Berlin	B. D. −16° 5478	I	−0.73	+0.66	+0.02	−0.59	−0.60	−0.08	+0.14	+0.56	−0.60	−3.9	−0.7
11	Berlin	87 B. Capricor.	I	−0.84	+0.61	+0.15	+0.42	+0.44	+0.12	+0.26	−0.27	−0.61	−6.1	−2.5
16	Greenwich	ζ Piscium	I	−0.97	−0.39	+0.45	+0.05	+0.45	+0.02	+0.28	+0.17	−0.02	−3.7	+0.5
19	Berlin	B. D. +16° 561	E	+0.82	+0.67	−0.56	+0.43	−0.71	+0.04	−0.15	−0.62	−0.60	+2.6	−0.8
19	Berlin	B. D. +16° 568	E	+1.10	+0.91	−0.08	+0.07	−0.12	+0.15	−0.19	−0.07	−0.74	+5.0	+0.5
19	Berlin	193 B. Tauri	E	+1.10	+0.91	−0.07	+0.06	−0.09	+0.16	−0.19	−0.06	−0.75	+5.9	+1.4
21	Berlin	B. D. +17° 1135	E	+1.09	+0.97	+0.05	−0.18	+0.20	+0.16	0.00	+0.20	−1.04	+3.9	−0.6
21	Berlin	B. D. +17° 1144	E	+1.04	+0.93	+0.11	−0.30	+0.34	+0.14	+0.01	+0.34	−1.00	+4.2	−0.1
21	Berlin	B. D. +18° 1112	E	+0.80	+0.71	−0.32	+0.66	−0.75	+0.15	0.00	−0.72	−0.77	+3.8	+0.5
21	Berlin	B. D. +17° 1158	E	+0.85	+0.76	+0.23	−0.57	+0.62	+0.10	0.00	+0.63	−0.82	+4.5	+1.0
21	Berlin	B. D. +17° 1161	E	+0.82	+0.73	+0.24	−0.61	+0.66	+0.09	+0.01	+0.66	−0.79	+4.1	+0.7
21	Berlin	124 H.^{1} Orionis	E	+1.10	+0.99	+0.02	−0.13	−0.14	+0.16	+0.01	+0.14	−1.07	+4.7	+0.2
21	Berlin	B. D. +18° 1147	E	+0.71	+0.64	−0.33	+0.73	−0.80	+0.15	+0.01	−0.80	−0.69	+3.6	+0.7
21	Berlin	B. D. +18° 1178	E	+0.90	+0.81	−0.25	+0.57	−0.62	+0.17	+0.02	−0.63	−0.90	+4.8	+1.1
21	Berlin	B. D. +18° 1179	E	+0.92	+0.83	−0.24	+0.55	−0.59	+0.17	+0.02	−0.60	−0.91	+4.3	+0.5
22	Berlin	λ Geminor	IB	−0.87	−0.82	−0.08	+0.58	−0.59	−0.05	−0.06	−0.47	+0.82	−4.6	−0.9
22	Berlin	λ Geminor.	E	+0.90	+0.78	−0.07	+0.54	−0.55	+0.13	+0.06	−0.62	−0.77	+3.1	−0.6
22	Berlin	B. D. +16° 1419	E	+1.06	+0.92	−0.09	+0.31	−0.31	+0.20	+0.11	−0.33	−1.09	+5.0	+0.6
22	Berlin	B. D. +16° 1421	E	+1.09	+0.95	−0.07	+0.21	−0.21	+0.19	+0.12	−0.23	−1.12	+5.8	+1.3
22	Berlin	B. D. +16° 1423	E	+0.99	+0.86	−0.11	+0.46	−0.46	+0.21	+0.10	−0.46	−1.02	+4.3	+0.2
22	Berlin	B. D. +16° 1426	E	+0.73	+0.64	−0.14	+0.75	−0.76	+0.21	+0.07	−0.74	−0.75	+3.4	+0.4
22	Berlin	B. D. +16° 1436	E	+0.98	+0.85	+0.03	−0.46	+0.46	+0.09	+0.07	+0.42	−1.01	+4.8	+0.8
22	Berlin	B. D. +16° 1441	E	+1.02	+0.88	−0.09	+0.41	−0.42	+0.20	+0.11	−0.42	−1.05	+[illegible].8	+0.6
22	Berlin	B. D. +16° 1448	E	+0.85	+0.74	+0.04	−0.63	+0.63	+0.04	+0.11	+0.58	−0.88	+4.9	+1.4
22	Cobham	λ Geminor.	E	+0.91	+0.81	−0.07	+0.55	−0.55	+0.20	+0.11	−0.56	−0.80	+2.9	−0.9
23	Berlin	B. D. +14° 1850	E	+1.10	+0.88	−0.04	+0.05	−0.05	+0.17	+0.21	−0.09	−1.14	+5.2	+0.7
23	Berlin	B. D. +14° 1854	E	+1.09	+0.88	−0.05	−0.12	+0.12	+0.13	+0.21	+0.04	−1.14	+4.8	+0.3
24	Berlin	κ Cancri	E	+1.04	+0.74	−0.03	−0.07	+0.08	+0.08	+0.24	+0.02	−0.98	+4.2	−0.1
24	Berlin	B. D. +10° 1956	E	+1.07	+0.73	−0.08	−0.13	+0.14	+0.11	+0.30	+0.02	−1.08	+4.2	−0.2
Nov. 6	Cape	283 B. Sagittarii	I	−0.81	+0.82	0.00	−0.44	−0.44	−0.03	+0.15	+0.45	−0.85	−3.3	+0.2
8	Berlin	B. D. −11° 5578	I	−0.85	+0.55	+0.21	+0.42	+0.46	+0.12	+0.29	−0.24	−0.69	−4.5	−0.8
8	Berlin	B. D. −11° 5583	I	−0.41	+0.26	+0.40	+0.84	+0.92	+0.24	+0.17	−0.59	−0.34	−1.1	+0.7
8	Berlin	B. D. −11° 5589	I	−0.86	+0.54	+0.21	+0.39	+0.44	+0.12	+0.31	−0.22	−0.70	−5.2	−1.4
11	Berlin	B. D. − 0° 4566	I	−0.94	−0.03	−0.25	−0.12	−0.26	−0.15	+0.36	+0.08	−0.52	−5.4	−1.3
11	Berlin	21 Piscium	I	−0.11	−0.01	−0.88	−0.44	−0.98	−0.32	0.00	+0.07	−0.06	−2.1	−1.6
14	Berlin	B. D. +12° 354	I	−1.03	−0.64	−0.18	+0.04	−0.18	−0.18	+0.30	−0.14	−0.02	−6.4	−1.9
14	Berlin	B. D. +12° 370	I	−1.06	−0.68	−0.08	+0.02	−0.08	−0.16	+0.31	−0.05	+0.01	−6.5	−1.8
17	Cape	57 Orionis	E	+1.00	+0.88	−0.20	+0.42	−0.46	+0.17	+0.03	−0.50	−0.43	+4.2	0.0
17	Berlin	B. D. +18° 990	E	+0.89	+0.80	−0.31	+0.57	−0.64	+0.16	−0.02	−0.63	−0.51	+4.7	+1.0
17	Berlin	B. D. +18° 1001	E	+1.05	+0.94	+0.11	−0.28	+0.31	+0.15	−0.02	+0.31	−0.61	+3.1	−1.3
17	Berlin	B. D. +18° 1012	E	+0.67	+0.59	−0.38	+0.75	−0.83	+0.12	−0.02	−0.83	−0.39	+3.7	+0.9
18	Berlin	B. D. +17° 1392	E	+0.90	+0.80	+0.11	−0.56	+0.57	+0.09	+0.06	+0.56	−0.63	+4.8	+1.0
18	Berlin	41 H^1. Geminor.	E	+0.62	+0.55	+0.11	−0.82	+0.83	0.00	+0.06	+0.80	−0.46	+2.9	+0.3
19	Berlin	B. D. +15° 1672	E	+1.10	+0.94	−0.05	−0.06	+0.06	+0.15	+0.18	0.00	−0.91	+3.6	−1.0
19	Berlin	B. D. +15° 1676	E	+0.49	+0.42	−0.04	−0.90	+0.90	−0.08	+0.09	+0.81	−0.40	+1.6	−0.4
20	Berlin	B. D. +12° 1927	E	+1.06	+0.82	+0.03	+0.21	−0.23	+0.20	+0.25	−0.23	−0.97	+4.6	+0.[illegible]
20	Berlin	60 Cancri	E	+1.08	+0.82	+0.01	+0.15	−0.16	+0.19	+0.26	−0.18	−0.99	+4.2	−0.3
20	Cobham	60 Cancri	E	+1.06	+0.82	+0.04	+0.11	−0.12	+0.15	+0.24	−0.14	−0.90	+4.5	+0.1
22	Berlin	34 Sextantis	E	+1.05	+0.50	−0.06	−0.06	+0.09	+0.10	+0.38	−0.02	−1.00	+4.1	−0.3
22	Berlin	B. D. + 3° 2406	E	+0.59	+0.27	−0.62	−0.60	+0.87	−0.20	+0.25	+0.28	−0.55	+2.5	0.0
22	Berlin	B. D. + 4° 2378	E	+1.03	+0.48	−0.19	−0.18	+0.27	+0.04	+0.39	+0.03	−0.97	+4.0	−0.3
22	Berlin	B. D. + 3° 2411	E	+1.01	+0.46	−0.24	−0.22	+0.33	+0.02	+0.38	+0.05	−0.96	+4.1	−0.1

GROUP XIII—1891-1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	b_0	α_e	δ_e	ε	P	n	n′
													″	″
1902, Dec. 4	Greenwich	β Capricor.	I	−0.71	+0.62	−0.12	−0.64	−0.65	−0.10	+0.14	+0.57	−0.63	−2.7	+0.4
11	Berlin	34 B. Arietis	I	−1.04	−0.54	−0.13	+0.02	−0.13	−0.16	+0.34	−0.07	−0.56	−6.3	−1.7
11	Berlin	B. D. +10° 292	I	−0.44	−0.24	+0.92	−0.16	+0.95	+0.18	+0.17	+0.50	−0.23	−0.7	+1.2
11	Berlin	B. D. +11° 295	I	−1.06	−0.59	−0.02	0.00	+0.02	−0.14	+0.34	−0.01	−0.53	−6.2	−1.5
12	Berlin	B. D. +13° 494	I	−1.07	−0.73	+0.11	−0.06	+0.16	−0.12	+0.29	+0.08	−0.41	−5.2	−0.5
13	Berlin	δ Tauri	I	−1.14	−0.88	−0.08	+0.08	−0.11	−0.20	+0.11	−0.08	−0.27	−5.8	−0.8
13	Berlin	64 Tauri	I	−1.11	−0.89	+0.19	−0.18	+0.27	−0.19	+0.10	+0.27	−0.26	−2.7	+2.2
13	Berlin	180 B. Tauri	I	−0.33	−0.27	−0.72	+0.58	−0.93	−0.16	+0.05	−0.82	−0.06	−1.9	−0.4
13	Berlin	B. D. +16° 561	I	−0.81	−0.65	−0.48	+0.39	−0.62	−0.19	+0.15	−0.58	−0.15	−4.4	−0.9
13	Berlin	193 B. Tauri	I	−1.10	−0.88	+0.01	−0.02	+0.02	−0.16	+0.19	0.00	−0.19	−7.5	−2.7
1903, Jan. 6	Berlin	171 B. Piscium	I	−0.97	−0.26	−0.24	−0.02	−0.24	−0.16	+0.35	−0.04	−0.86	−3.8	+0.5
9	Berlin	B. D. +15° 531	I	−1.07	−0.81	−0.11	+0.07	−0.12	−0.17	+0.23	−0.13	−0.70	−5.8	−1.1
12	Berlin	B. D. +17° 1409	I	−0.82	−0.73	−0.10	+0.66	−0.67	−0.06	−0.06	−0.65	−0.17	−5.0	−1.4
14	Cobham	α Cancri	E	+1.06	+0.80	+0.13	+0.34	−0.37	+0.27	+0.21	−0.33	−0.24	+6.7	+2.2
15	Berlin	B. D. + 7° 2227	E	+1.08	+0.71	−0.09	−0.10	+0.13	+0.12	+0.34	0.00	−0.41	+5.0	+0.5
15	Berlin	B. D. + 7° 2232	E	+0.93	+0.61	+0.28	+0.36	−0.46	+0.26	+0.29	−0.29	−0.36	+5.0	+1.1
18	Berlin	B. D. − 6° 3656	E	+1.00	+0.06	0.00	−0.01	+0.04	+0.07	+0.39	−0.02	−0.76	+4.6	+0.4
19	Berlin	h Virginis	E	+0.69	−0.09	−0.75	+0.04	+0.77	−0.18	+0.29	−0.31	−0.56	+3.6	+0.7
19	Berlin	B. D. − 9° 3736	E	+0.66	−0.11	+0.70	−0.06	−0.70	+0.23	+0.22	+0.30	−0.53	+4.0	+1.2
20	Berlin	6 G. Libræ	E	+0.75	−0.28	+0.55	−0.16	−0.55	+0.15	+0.24	+0.34	−0.62	+3.2	0.0
Feb. 2	Berlin	B. D. + 3° 86	I	−0.93	−0.11	+0.43	+0.08	+0.47	+0.07	+0.38	+0.11	−0.75	−4.5	−0.4
6	Berlin	64 Tauri	I	−0.53	−0.43	−0.59	+0.64	−0.87	−0.06	+0.05	−0.78	−0.45	−3.0	−0.7
6	Berlin	B. D. +16° 577	I	−1.00	−0.79	+0.33	−0.33	+0.47	−0.09	+0.17	−0.41	−0.91	−4.4	0.0
6	Berlin	B. D. +16° 582	I	−1.07	−0.84	+0.21	−0.21	+0.30	−0.12	+0.18	+0.26	−0.96	−2.1	+2.6
6	Berlin	B. D. +16° 591	I	−0.95	−0.76	+0.38	−0.40	+0.55	−0.08	+0.15	+0.49	−0.85	−5.2	−1.0
6	Berlin	B. D. +17° 722	I	−0.64	−0.51	−0.52	+0.57	−0.78	−0.18	+0.09	−0.73	−0.57	−2.9	−0.1
6	Berlin	B. D. +16° 600	I	−1.05	−0.84	+0.25	−0.27	+0.36	−0.11	+0.16	+0.31	−0.94	−2.2	+2.4
6	Berlin	B. D. +16° 602	I	−0.72	−0.58	+0.54	−0.58	+0.79	−0.02	+0.11	+0.71	−0.64	−2.8	+0.4
6	Berlin	B. D. +16° 606	I	−1.09	−0.88	−0.04	+0.05	−0.06	−0.17	+0.16	−0.08	−0.97	−5.6	−0.8
7	Berlin	B. D. +18° 825	I	−1.03	−0.90	−0.14	+0.27	−0.32	−0.17	+0.08	−0.32	−0.85	−4.8	−0.3
7	Berlin	115 Tauri	I	−1.01	−0.87	+0.24	−0.40	+0.45	−0.14	+0.06	+0.44	−0.81	−4.2	+0.3
7	Cape	352 B. Tauri	I	−1.01	−0.85	−0.20	+0.35	−0.41	−0.16	+0.03	−0.37	−0.74	−4.4	+0.1
9	Berlin	68 Geminor.	I	−1.10	−0.95	−0.01	−0.26	+0.26	−0.17	−0.15	+0.26	−0.46	−5.1	−0.2
9	Berlin	B. D. +16° 1506	I	−1.10	−0.97	+0.05	+0.19	−0.19	−0.14	−0.16	−0.15	−0.58	−5.7	−0.8
9	Berlin	67 Geminor.	I	−0.48	−0.43	−0.01	−0.90	+0.90	−0.19	+0.06	−0.87	−0.25	−4.0	−1.9
9	Berlin	B. D. +15° 1605	I	−0.88	−0.77	+0.01	−0.61	+0.61	−0.21	−0.12	+0.60	−0.46	−5.8	−1.9
9	Berlin	B. D. +16° 1518	I	−1.12	−0.98	+0.04	−0.05	+0.05	−0.17	−0.16	+0.09	−0.58	−6.5	−1.6
12	Berlin	155 B. Leonis	E	+1.06	+0.66	−0.14	−0.14	+0.20	+0.08	+0.37	+0.03	+0.02	+5.4	+0.9
15	Berlin	487 B. Virginis	E	+0.94	−0.03	+0.27	−0.01	+0.27	+0.14	+0.35	+0.08	−0.51	+5.7	+1.7
16	Berlin	B. D. −11° 3659	E	+0.66	−0.15	−0.74	+0.17	+0.79	−0.17	+0.27	−0.41	−0.43	+4.3	+1.5
16	Berlin	B. D. −11° 3668	E	+0.88	−0.22	+0.36	−0.08	−0.37	+0.12	+0.31	+0.22	−0.58	+4.9	+1.1
16	Berlin	B. D. −11° 3684	E	+0.96	−0.27	+0.04	−0.01	−0.04	+0.05	+0.35	+0.05	−0.65	+5.7	+1.6
19	Cape	24 Scorpii	E	+0.91	−0.85	+0.01	−0.01	−0.01	−0.04	+0.10	−0.01	−0.99	+5.1	+1.2
Mar. 2	Berlin	B. D. + 6° 195	I	−1.02	−0.22	+0.02	0.00	+0.07	−0.08	+0.38	+0.01	−0.67	−3.9	+0.7
4	Berlin	B. D. +13° 499	I	−0.88	−0.52	−0.45	+0.24	−0.49	−0.21	+0.23	−0.39	−0.82	−4.8	−0.9
5	Cape	173 B. Tauri	I	−0.32	−0.23	+0.68	−0.66	+0.95	+0.10	+0.05	+0.83	−0.31	−2.5	−1.1
6	Berlin	B. D. +17° 841	I	+1.06	−0.88	−0.10	+0.19	−0.23	−0.16	+0.10	−0.24	−1.08	−4.4	+0.4
7	Berlin	B. D. +17° 1082	I	−1.02	−0.90	+0.17	−0.40	+0.43	−0.16	+0.02	+0.43	−1.04	−4.4	+0.2
7	Berlin	B. D. +17° 1089	I	−1.11	−0.97	+0.07	−0.11	+0.12	−0.17	+0.02	+0.11	−1.12	−4.1	+0.9
7	Berlin	B. D. +18° 1061	I	−0.98	−0.87	−0.11	+0.41	−0.44	−0.14	+0.01	−0.44	−1.00	−4.1	+0.3
7	Berlin	B. D. +18° 1060	I	−0.82	−0.72	−0.18	+0.62	−0.66	−0.11	+0.01	−0.64	−0.83	−4.0	−0.3
7	Berlin	B. D. +18° 1067	I	−1.00	−0.88	−0.10	+0.40	−0.42	−0.14	+0.01	−0.42	−1.00	−3.7	+0.8
7	Berlin	B. D. +17° 1101	I	−0.69	−0.60	+0.27	[illegible]	+0.80	−0.12	0.00	+0.81	−0.69	−3.7	−0.6
7	Berlin	B. D. +17° 1113	I	−1.08	−0.95	+0.12	−0.25	+0.26	−0.17	0.00	+0.26	−1.09	−2.2	+2.6
7	Berlin	B. D. +18° 1084	I	−0.40	−0.35	−0.26	+0.89	−0.93	−0.04	0.00	−0.93	−0.40	−1.0	+0.8
7	Berlin	B. D. +17° 1135	I	−1.02	−0.90	−0.08	+0.37	−0.38	−0.14	−0.01	−0.38	−1.02	−3.5	+1.1
7	Berlin	B. D. +17° 1144	I	−1.01	−0.89	−0.08	+0.39	−0.41	−0.14	−0.01	−0.41	−1.01	−3.7	+0.8
7	Berlin	B. D. +17° 1147	I	−1.11	−0.98	+0.02	+0.04	−0.04	−0.17	−0.01	−0.04	−1.11	−4.9	+0.1
7	Berlin	B. D. +17° 1151	I	−1.11	−0.98	+0.03	+0.01	−0.03	−0.17	−0.01	−0.01	−1.11	−5.4	−0.4
7	Berlin	B. D. +17° 1158	I	−0.98	−0.87	−0.09	+0.44	−0.46	−0.13	−0.02	−0.46	−0.98	−3.9	+0.5
7	Berlin	B. D. +17° 1154	I	−0.37	−0.33	+0.27	−0.91	+0.95	−0.09	−0.01	+0.95	−0.38	−2.5	−0.9
8	Berlin	B. D. +17° 1469	I	−1.11	−0.99	+0.03	+0.14	−0.14	−0.15	−0.10	−0.11	−1.06	−4.5	+0.5
8	Berlin	B. D. +17° 1477	I	−1.07	−0.95	+0.02	+0.30	−0.30	−0.13	−0.10	−0.27	−1.02	−4.2	+0.6
8	Berlin	41 H′. Geminor.	I	−0.84	−0.75	+0.08	−0.67	+0.67	−0.19	−0.08	+0.66	−0.80	−5.7	−1.9
8	Berlin	B. D. +16° 1373	I	−1.11	−0.99	+0.05	−0.12	+0.12	−0.18	−0.11	+0.14	−1.06	−4.0	+1.0
8	Berlin	B. D. +16° 1380	I	−1.12	−1.00	+0.05	−0.05	+0.05	−0.17	−0.10	+0.07	−1.06	−5.4	−0.4
8	Berlin	B. D. +17° 1488	I	−0.13	−0.12	−0.05	+1.00	−1.00	+0.08	−0.02	−0.97	−0.13	−1.0	−0.4
8	Berlin	B. D. +16° 1385	I	−1.12	−1.00	+0.04	−0.02	+0.04	−0.17	−0.11	+0.06	−1.06	−5.6	−0.6
8	Berlin	B. D. +16° 1395	I	−1.11	−1.00	+0.04	+0.10	−0.11	−0.16	−0.12	−0.07	−1.05	−5.4	−0.4
8	Berlin	B. D. +16° 1398	I	−1.06	−0.95	+0.05	−0.31	+0.32	−0.19	−0.11	+0.33	−1.00	−3.1	+1.6

GROUP XIII—1891-1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1903, Mar. 8	Berlin	B. D.+16° 1400	I	−1.12	−0.99	+0.02	0.00	+0.02	−0.17	−0.12	+0.03	−1.06	−5.0	0.0
8	Berlin	51 Geminor.	I	−0.85	−0.77	+0.05	−0.64	+0.64	−0.20	−0.09	+0.64	−0.80	−5.8	−2.0
8	Berlin	B. D.+16° 1421	I	−0.37	−0.33	0.00	+0.95	−0.95	+0.05	−0.05	−0.90	−0.35	−0.9	+0.7
8	Cobham	51 Geminor.	I	−0.60	−0.55	+0.01	−0.84	+0.84	−0.18	−0.06	+0.82	−0.47	−3.1	−0.4
12	Berlin	B. D.+ 2° 2386	I	−1.04	−0.53	−0.08	−0.04	+0.08	−0.16	−0.38	+0.07	−0.34	−5.1	−0.4
12	Berlin	*p* Leonis	I	−1.03	−0.52	+0.25	+0.17	−0.32	−0.03	−0.39	−0.03	−0.34	−5.1	−0.5
17	Berlin	34 Libræ	E	+0.94	−0.55	0.00	0.00	0.00	0.00	+0.25	+0.03	−0.56	+5.0	+1.0
17	Berlin	ζ Libræ	E	+0.86	−0.55	−0.36	+0.28	+0.46	−0.08	+0.23	−0.34	−0.52	+4.8	+1.1
Apr. 4	Cape	74 B. Geminor.	I	−0.73	−0.68	+0.08	−0.73	+0.73	−0.15	−0.06	+0.75	−0.68	−2.4	+0.9
May 2	Greenwich	68 Geminor.	I	−1.11	−0.98	+0.02	+0.20	−0.20	−0.11	−0.14	−0.20	−0.94	−4.3	+0.7
June 2	Greenwich	p^4 Leonis	I	−0.91	−0.60	−0.08	−0.48	+0.48	−0.23	−0.25	+0.16	−0.88	−3.8	+0.3
2	Cobham	p^4 Leonis	I	−0.91	−0.59	−0.43	−0.23	+0.49	−0.23	−0.25	+0.16	−0.87	−4.3	+0.2
Aug. 1	Cape	η Libræ	I	−0.93	−0.44	+0.09	−0.09	−0.13	+0.03	+0.09	−0.07	−0.97	−5.3	−1.0
Sept. 2	Cape	54 Sagittarii	I	−0.55	+0.60	+0.19	+0.77	+0.79	+0.13	+0.09	−0.72	−0.47	−3.1	−0.5
2	Cape	*e* Sagittarii	I	−0.79	+0.87	+0.12	+0.46	+0.47	+0.11	+0.12	−0.40	−0.68	−5.9	−2.2
3	Greenwich	27 G. Capricor.	I	−0.93	+1.00	+0.01	+0.02	+0.02	+0.06	+0.19	−0.02	−0.57	−5.4	−1.0
Oct. 22	Cape	γ Libræ	I	−0.65	−0.17	+0.50	−0.57	−0.76	+0.10	−0.13	+0.63	−0.20	−2.6	+0.4
30	Cobham	ρ Aquarii	I	−0.30	+0.30	−0.80	−0.50	−0.94	−0.25	+0.06	+0.44	−0.29	−1.0	+0.4
30	Greenwich	ρ Aquarii	I	−0.30	+0.30	−0.79	−0.51	−0.94	−0.25	+0.06	+0.42	−0.29	−0.8	+0.6
Nov. 4	Greenwich	ξ Arietis	I	−0.79	−0.03	+0.56	−0.33	+0.66	+0.11	+0.21	+0.41	+0.01	−2.5	+1.2
9	Greenwich	λ Geminor.	E	+1.02	+0.83	+0.09	+0.42	−0.43	+0.16	+0.09	−0.39	−0.79	+0.2	−4.4
Dec. 2	Greenwich	W. B. II 1033	I	−0.58	−0.07	+0.61	−0.58	+0.84	+0.13	+0.14	+0.61	−0.17	−3.4	−0.6
4	Greenwich	318 B. Tauri	IB	−1.03	−0.52	+0.15	−0.41	+0.44	−0.09	+0.08	+0.44	+0.11	−4.6	+0.3
4	Greenwich	318 B. Tauri	EB	+0.92	+0.47	+0.20	−0.55	+0.59	+0.16	−0.06	+0.58	−0.10	+2.3	−1.8
10	Greenwich	*d* Leonis	IB	−0.53	−0.46	−0.82	−0.30	+0.87	−0.32	−0.11	+0.25	+0.49	−3.4	−0.9
10	Greenwich	*d* Leonis	E	+0.57	+0.49	−0.79	−0.29	+0.84	−0.19	+0.20	+0.26	−0.52	+2.5	−0.1
31	Greenwich	75 Tauri	I	−0.73	−0.29	+0.33	−0.68	+0.76	+0.01	+0.09	+0.31	−0.29	−2.0	+1.5
31	Greenwich	75 Tauri	EB	+0.58	+0.23	+0.36	−0.77	+0.86	+0.17	−0.06	+0.33	+0.23	+3.8	+1.1
31	Cape	119 H′. Tauri	I	−1.05	−0.36	+0.09	−0.21	+0.23	−0.10	+0.12	+0.22	−0.44	−2.8	+2.2
31	Cape	68 Tauri	I	−0.93	−0.28	−0.22	+0.45	−0.50	−0.17	+0.11	−0.51	−0.39	−6.3	−1.8
1904, Jan. 4	Kasan	29 Cancri	IB	−1.03	−0.87	+0.23	+0.36	−0.43	−0.10	−0.18	−0.35	+0.31	−6.3	−1.4
4	Kasan	29 Cancri	E	+1.07	+0.91	+0.19	+0.30	−0.35	+0.25	+0.17	−0.30	−0.32	+6.6	+1.7
Feb. 24	Kasan	θ^1 Tauri	EB	+0.32	+0.12	+0.36	−0.88	+0.95	+0.15	−0.03	+0.86	+0.30	+0.1	−1.4
24	Utrecht	α Tauri	I	−1.00	−0.39	−0.06	+0.16	−0.17	−0.08	+0.12	−0.16	−0.96	−4.8	0.0
24	Wilhelmshaven	α Tauri	I	−0.99	−0.38	−0.08	+0.21	−0.23	−0.06	+0.11	−0.21	+0.96	−5.8	−1.0
24	Wilhelmshaven	α Tauri	EB	+1.00	+0.38	−0.07	+0.19	−0.20	+0.06	−0.12	−0.19	−0.95	+4.2	−0.4
29	Kasan	*o* Leonis	I	−1.15	−1.00	+0.06	+0.05	−0.08	−0.19	+0.26	−0.05	−0.27	−6.4	−0.9
29	Kasan	*o* Leonis	EB	+1.12	+0.97	+0.20	+0.15	−0.25	+0.27	+0.24	−0.16	+0.26	+4.3	−1.0
29	Englehardt	*o* Leonis	I	−1.15	−1.00	+0.06	+0.04	−0.07	−0.19	+0.25	−0.06	−0.27	−7.2	−1.7
29	Englehardt	*o* Leonis	EB	+1.12	+0.97	+0.20	+0.14	−0.25	+0.16	+0.23	−0.15	+0.26	+6.6	+1.4
Mar. 4	Cape	*l* Virginis	E	+0.79	+0.38	+0.64	−0.28	−0.69	+0.31	+0.18	+0.29	−0.40	+2.8	−0.9
22	Greenwich	θ^1 Tauri	I	−0.67	−0.22	+0.26	−0.70	+0.74	−0.04	+0.10	+0.69	−0.64	−2.8	+0.5
22	Greenwich	75 Tauri	I	−0.62	−0.16	−0.27	+0.73	−0.78	−0.02	+0.08	−0.72	−0.60	−4.4	−1.4
22	Kasan	γ Tauri	I	−0.47	−0.12	+0.34	−0.81	+0.88	+0.09	+0.08	+0.78	−0.76	−5.7	−3.4
22	Kasan	γ Tauri	EB	+0.56	+0.17	+0.31	−0.77	+0.83	+0.14	−0.07	+0.77	+0.58	+4.0	+1.4
22	Englehardt	γ Tauri	I	−0.44	+0.21	+0.32	−0.83	+0.90	+0.13	+0.09	+0.64	+0.67	−5.1	−2.9
27	Kasan	209 B. Cancri	I	−0.34	−0.30	−0.70	−0.64	+0.95	−0.25	−0.05	+0.69	−0.22	−4.6	−2.9
27	Englehardt	209 B. Cancri	EB	+0.51	+0.45	−0.66	−0.60	+0.89	−0.11	+0.12	+0.64	+0.32	−2.4	−4.8
Apr. 22	Cape	2 B. Cancri	I	−0.98	−0.78	−0.21	−0.33	+0.39	−0.15	−0.13	−0.58	−0.92	−3.0	+1.8
24	Kasan	83 B. Leonis	I	−0.96	−0.88	+0.42	+0.25	−0.48	−0.01	−0.25	−0.26	−0.79	−3.5	+1.2
24	Greenwich	10 Sextantis	I	−1.06	−0.97	−0.20	−0.11	+0.23	−0.11	−0.24	+0.11	−0.88	−4.9	+0.3
28	Englehardt	*m* Virginis	I	−0.74	−0.41	+0.63	−0.36	−0.73	+0.11	−0.23	+0.31	−0.17	−0.7	+2.9
May 1	Cape	φ Ophiuchi	E	+1.01	−0.12	+0.05	−0.16	−0.17	+0.10	+0.13	+0.37	−0.38	+5.5	+0.7
21	Kasan	*o* Leonis	I	−0.97	−0.90	−0.36	−0.22	+0.42	−0.22	−0.22	+0.28	−0.91	−3.0	+1.8
24	Cape	η Virginis	I	−1.08	−0.87	−0.02	0.00	+0.02	−0.14	−0.31	−0.02	−0.87	−6.9	−1.6
June 4	Cape	ρ Aquarii	E	+0.81	−0.90	−0.42	−0.16	−0.44	−0.16	−0.26	+0.21	−0.88	+5.3	+1.5
July 7	Cape	38 Arietis	E	+0.96	−0.45	−0.09	+0.10	−0.13	−0.01	−0.04	−0.08	−0.84	+3.6	−1.0
9	Greenwich	θ^1 Tauri	E	+1.03	+0.08	+0.02	−0.07	+0.07	+0.16	−0.14	+0.41	−0.58	+7.4	+2.5
9	Greenwich	θ^2 Tauri	E	+0.93	+0.09	+0.11	−0.41	+0.43	−0.03	−0.16	+0.09	−0.52	+6.9	+2.5
9	Greenwich	264 B. Tauri	IB	−0.86	−0.08	−0.14	+0.52	−0.54	−0.04	+0.13	−0.47	+0.49	−6.9	−2.6
9	Greenwich	α Tauri	IB	−0.76	−0.07	−0.16	+0.65	−0.67	−0.05	+0.10	−0.63	+0.41	−5.5	−1.7
9	Greenwich	α Tauri	E	+0.88	+0.08	−0.12	+0.51	−0.53	+0.06	−0.12	−0.76	−0.48	+4.7	+0.5
18	Cape	38 Virginis	I	−0.54	−0.42	−0.80	+0.32	−0.86	−0.33	−0.12	−0.20	−0.48	−2.4	+0.3
22	Cape	φ Ophiuchi	I	−0.95	−0.03	−0.06	+0.23	+0.24	−0.06	−0.13	−0.24	−0.83	−4.1	+0.6
Aug. 30	Greenwich	ξ^1 Ceti	E	+0.92	−0.02	+0.01	−0.01	+0.02	−0.07	−0.25	+0.04	−0.87	+5.4	+1.0
Sept. 13	Cape	13 Libræ	I	−1.06	−0.52	−0.11	+0.16	+0.19	−0.17	−0.23	−0.16	−0.68	−5.1	+0.2
22	Cape	67 Aquarii	I	−0.79	+0.87	+0.46	+0.08	+0.47	+0.18	+0.27	−0.19	−0.40	−5.9	−1.9
27	Utrecht	85 Ceti	E	+0.93	−0.53	+0.03	+0.04	−0.04	−0.02	−0.25	0.00	−0.62	+4.4	−0.1
29	Cobham	γ Tauri	E	+0.81	−0.10	−0.12	+0.53	−0.54	−0.07	−0.14	−0.53	−0.75	+4.1	+0.2
29	Cobham	θ^1 Tauri	E	+0.95	−0.10	+0.03	−0.16	+0.16	+0.04	−0.14	+0.17	−0.88	+3.0	−1.6

GROUP XIII—1891-1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ε	P	n	n'
													″	″
1904, Sept. 29	Cobham	θ^2 Tauri	E	+0.83	−0.09	+0.10	−0.51	+0.52	+0.09	−0.12	−0.50	−0.77	+3.4	−0.6
29	Greenwich	θ^1 Tauri	IB	−0.96	+0.10	−0.01	+0.02	−0.02	0.00	+0.15	−0.04	+0.88	−5.3	−0.5
29	Greenwich	θ^1 Tauri	E	+0.95	−0.10	+0.03	−0.15	+0.16	0.00	−0.15	+0.15	−0.87	+4.1	−0.5
29	Greenwich	θ^2 Tauri	IB	−0.90	+0.09	+0.07	−0.34	−0.35	−0.01	+0.15	+0.30	+0.83	−2.2	+2.3
29	Greenwich	θ^2 Tauri	E	+0.83	−0.09	+0.09	−0.51	+0.51	−0.01	−0.13	+0.47	−0.76	+4.2	+0.2
29	Greenwich	264 B. Tauri	IB	−0.85	+0.09	−0.09	+0.46	−0.47	0.00	+0.14	−0.40	−0.36	−5.6	−1.4
29	Greenwich	γ Tauri	E	+0.81	−0.08	−0.12	+0.53	−0.54	0.00	−0.14	−0.48	−0.74	+4.2	+0.3
29	Greenwich	71 Tauri	E	+0.37	−0.04	+0.18	−0.91	+0.92	0.00	−0.05	+0.85	−0.33	+2.1	+0.3
Oct. 27	Cape	m Tauri	E	+0.81	−0.06	+0.01	+0.56	−0.56	−0.03	−0.09	−0.52	−0.60	+3.9	0.0
Nov. 20	Cobham	64 Ceti	I	−0.86	+0.66	+0.27	−0.30	+0.40	+0.12	+0.27	+0.17	−0.37	−4.0	+0.4
20	Cobham	ξ^1 Ceti	I	−0.94	+0.72	+0.01	−0.01	+0.01	+0.01	+0.28	−0.03	−0.41	−4.4	+0.4
20	Greenwich	64 Ceti	I	−0.86	+0.66	+0.27	−0.30	+0.40	+0.05	+0.27	+0.17	−0.34	−3.8	+0.8
20	Greenwich	ξ^1 Ceti	I	−0.94	+0.68	+0.01	−0.01	+0.01	+0.01	+0.28	−0.04	−0.37	−4.8	0.0
23	Kasan	α Tauri	E	+0.61	−0.11	−0.08	+0.78	−0.79	−0.08	−0.10	−0.73	−0.11	+4.4	+1.4
Dec. 16	Cape	77 Piscium	I	−0.82	+0.84	−0.38	+0.24	−0.44	−0.11	+0.26	−0.13	−0.83	−5.4	−1.2
20	Greenwich	γ Tauri	I	−0.97	+0.29	+0.03	−0.17	+0.17	−0.02	+0.16	+0.11	−0.36	−4.7	+0.2
20	Greenwich	γ Tauri	EB	+0.92	−0.27	+0.06	−0.36	+0.37	+0.03	−0.14	+0.36	+0.34	+3.3	−1.2
20	Greenwich	70 Tauri	I	−0.92	+0.27	+0.05	−0.37	+0.38	−0.03	+0.15	+0.32	−0.34	−2.3	+2.4
20	Greenwich	75 Tauri	I	−0.77	+0.23	−0.07	+0.62	−0.63	−0.02	+0.11	−0.59	−0.29	−4.0	−0.1
20	Greenwich	B. D. +15° 633	I	−0.97	+0.28	+0.02	−0.20	+0.20	−0.03	+0.16	+0.17	−0.36	−4.8	+0.1
20	Greenwich	θ^1 Tauri	I	−0.45	+0.13	+0.10	−0.89	+0.89	−0.02	+0.08	+0.80	−0.17	−3.0	−0.7
20	Greenwich	θ^1 Tauri	EB	+0.40	−0.12	+0.10	−0.91	+0.92	+0.01	−0.06	+0.85	+0.15	−0.5	−2.5
20	Greenwich	264 B. Tauri	I	−0.95	+0.28	+0.03	−0.30	+0.30	−0.03	+0.13	+0.28	−0.35	−2.6	+2.2
20	Greenwich	α Tauri	I	−0.91	+0.26	−0.03	+0.41	−0.41	−0.04	+0.12	−0.41	−0.34	−4.1	+0.5
20	Cobham	75 Tauri	I	−0.78	+0.20	−0.07	+0.62	−0.62	+0.14	+0.14	−0.58	−0.29	−3.3	+0.7
20	Utrecht	75 Tauri	I	−0.76	+0.22	−0.07	+0.63	−0.64	−0.13	+0.11	−0.60	−0.28	−4.5	−0.6
20	Kasan	θ^1 Tauri	I	−0.84	+0.18	+0.06	−0.53	+0.53	+0.04	+0.06	+0.52	−0.31	−4.7	−0.4
20	Kasan	θ^2 Tauri	I	−0.49	+0.11	+0.09	−0.87	+0.87	+0.11	+0.08	+0.55	−0.18	−4.2	−1.7
20	Kasan	48 Tauri	I	−0.78	+0.23	+0.10	−0.60	+0.61	+0.06	−0.27	+0.52	−0.29	−6.5	−2.5
20	Kasan	γ Tauri	I	−0.76	+0.22	+0.10	−0.64	+0.64	+0.07	+0.13	+0.55	−0.28	−5.4	−1.5
20	Englehardt	48 Tauri	I	−0.78	+0.23	+0.10	−0.60	+0.61	+0.07	+0.15	+0.51	−0.30	−5.8	−1.8
20	Englehardt	γ Tauri	I	−0.76	+0.22	+0.10	−0.63	+0.64	+0.07	+0.14	+0.55	−0.28	−4.5	−0.6
20	Englehardt	θ^1 Tauri	I	−0.84	+0.18	+0.06	−0.53	+0.54	+0.02	+0.14	+0.45	−0.31	−3.7	+0.6
20	Englehardt	θ^2 Tauri	I	−0.49	+0.11	+0.09	−0.87	+0.87	+0.11	+0.08	+0.78	−0.18	−3.8	−1.3
20	Englehardt	θ^2 Tauri	EB	+0.58	−0.13	+0.08	−0.81	+0.81	+0.14	−0.08	+0.76	+0.22	+1.2	−1.6
1905, Jan. 10	Greenwich	φ Aquarii	I	−0.82	+0.86	−0.46	+0.03	−0.46	−0.11	+0.25	+0.09	−0.73	−4.6	−0.4
10	Greenwich	φ Aquarii	EB	+0.87	−0.94	−0.22	+0.02	−0.22	−0.11	−0.31	+0.07	+0.80	+2.9	−1.4
16	Tokio	264 B. Tauri	IB	−0.97	+0.29	0.00	+0.03	−0.03	−0.03	+0.15	−0.05	−0.65	−8.1	−3.2
16	Tokio	269 B. Tauri	IB	−0.95	+0.28	+0.02	−0.20	+0.20	+0.01	+0.15	+0.17	−0.64	−6.5	−1.7
16	Tokio	264 B. Tauri	E	+0.93	−0.27	+0.02	−0.27	+0.27	+0.06	−0.15	+0.28	+0.62	+3.1	−1.5
17	Tokio	α Tauri	IB	−0.97	+0.29	+0.01	−0.10	+0.10	−0.01	+0.15	+0.06	−0.65	−6.6	−1.7
17	Tokio	α Tauri	E	+0.96	−0.29	+0.01	−0.16	+0.16	+0.05	−0.14	+0.18	+0.64	+5.5	+0.8
17	Greenwich	318 B. Tauri	I	−0.73	+0.15	+0.02	+0.71	−0.71	−0.12	+0.08	−0.69	−0.45	−5.1	−1.4
18	Kasan	130 Tauri	I	−0.87	−0.03	−0.12	−0.48	+0.49	−0.02	+0.04	+0.47	−0.37	−5.9	−1.5
18	Greenwich	130 Tauri	I	−1.04	−0.02	−0.06	−0.25	+0.26	−0.06	+0.05	+0.25	−0.45	−6.2	−0.9
19	Greenwich	26 Geminor.	I	−0.74	−0.16	−0.34	−0.67	+0.75	−0.08	−0.01	+0.71	−0.18	−5.0	−1.2
26	Cape	80 Virginis	E	+1.04	+0.90	−0.19	+0.17	+0.25	−0.05	+0.31	−0.06	−0.93	+4.2	+0.9
Feb. 13	Utrecht	θ^1 Tauri	I	−0.89	+0.32	−0.03	+0.36	−0.38	−0.07	+0.14	−0.37	−0.87	−3.1	+1.4
13	Kasan	70 Tauri	I	−0.69	+0.23	−0.05	+0.69	−0.69	−0.11	+0.11	−0.66	−0.94	−3.9	−0.4
13	Kasan	71 Tauri	I	−0.69	+0.24	+0.05	−0.65	+0.65	+0.13	+0.13	+0.57	−0.71	−3.9	−0.4
17	Utrecht	23 H¹. Cancri	I	−1.01	−0.53	−0.24	−0.20	+0.31	−0.16	−0.15	+0.26	−0.35	−5.8	−0.6
20	Tokio	c Leonis	E	+0.92	+0.79	−0.54	+0.02	+0.54	−0.03	+0.28	+0.19	−0.18	+5.6	+1.1
21	Utrecht	η Virginis	E	+0.82	+0.72	−0.64	+0.27	+0.70	−0.08	+0.27	−0.02	−0.37	+4.8	+0.8
Mar. 10	Kasan	389 B. Ceti	I	−0.86	+0.76	−0.18	+0.29	−0.34	−0.06	+0.25	−0.24	−0.76	−4.8	−0.3
12	Greenwich	48 Tauri	I	−0.96	+0.42	+0.01	−0.14	+0.14	+0.04	+0.17	+0.09	−0.98	−6.1	−1.1
15	Utrecht	110 B. Geminor.	I	−0.93	−0.24	+0.25	+0.35	−0.43	−0.06	−0.04	−0.45	−0.79	−3.9	+0.9
16	Greenwich	2 B. Cancri	I	−1.03	−0.45	−0.27	+0.21	−0.34	−0.06	−0.11	−0.34	−0.70	−4.3	+1.1
17	Cape	o^1 Cancri	I	−1.04	−0.55	+0.28	+0.14	−0.31	−0.08	−0.19	−0.28	−0.58	−5.4	0.0
18	Tokio	44 Leonis	I	−0.78	−0.62	−0.68	−0.08	+0.69	−0.29	−0.17	+0.29	−0.25	−8.2	−4.1
19	Greenwich	56 Leonis	I	−1.07	−0.85	−0.39	0.00	+0.39	−0.30	−0.25	+0.11	−0.21	−3.3	+2.3
20	Utrecht	β Virginis	I	−0.84	−0.74	−0.62	+0.22	+0.65	−0.33	−0.21	+0.03	−0.03	−7.3	−2.9
20	Utrecht	β Virginis	EB	+0.94	+0.83	−0.50	+0.18	+0.53	−0.03	+0.29	+0.08	+0.03	+4.0	−0.7
Apr. 12	Kasan	162 B. Geminor.	I	−0.98	−0.33	−0.23	−0.24	+0.34	−0.12	−0.08	+0.29	−0.93	−3.5	+1.6
12	Englehardt	162 B. Geminor.	I	−0.98	−0.33	−0.23	−0.24	+0.34	−0.12	−0.08	+0.29	−0.93	−4.0	+1.1
12	Englehardt	162 B. Geminor.	EB	+1.02	+0.34	−0.13	−0.13	+0.18	+0.07	+0.09	+0.19	+0.97	+4.4	−0.7
12	Greenwich	162 B. Geminor.	I	−0.03	−0.01	−0.69	−0.72	+1.00	−0.08	0.00	+0.93	−0.03	−0.6	−0.4
15	Greenwich	44 Leonis	I	−1.11	−0.88	+0.09	+0.01	−0.09	−0.14	−0.27	−0.08	−0.68	−8.6	−2.8
15	Greenwich	44 Leonis	EB	+1.07	+0.84	+0.29	+0.01	−0.29	+0.23	+0.25	−0.09	+0.65	+8.0	+2.6
16	Cape	σ Leonis	I	−0.67	+0.57	+0.79	−0.14	−0.81	+0.14	−0.22	−0.23	−0.32	−4.0	−0.5
17	Greenwich	η Virginis	I	−0.87	−0.76	−0.59	+0.28	+0.65	−0.36	−0.21	−0.06	−0.28	−7.5	−3.0

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1905, Apr. 24	Cape	ρ Sagittarii	E	+0.94	−0.02	−0.21	−0.24	−0.32	+0.02	−0.07	+0.38	−0.87	+ 4.4	−0.3
May 10	Cape	ζ Cancri	I	−0.95	+0.43	+0.27	+0.19	−0.35	−0.[illegible]	−0.13	−0.34	−0.98	− 5.5	−0.5
10	Cape	Pi. VIII 6	I	−0.95	+0.43	+0.27	+0.19	−0.35	−0.01	−0.13	−0.35	−0.93	− 5.6	−0.6
13	Kasan	56 Leonis	I	−0.34	−0.28	−0.95	+0.10	+0.95	−0.33	−0.05	+0.29	−0.28	− 3.8	−2.0
13	Kasan	c Leonis	I	−1.03	−0.86	+0.35	−0.04	−0.35	−0.04	−0.29	−0.14	−0.85	− 4.7	+0.7
14	Kasan	β Virginis	I	−0.62	−0.54	−0.78	+0.28	+0.83	−0.36	−0.14	+0.04	−0.44	− 2.7	+0.6
15	Greenwich	38 Virginis	I	−0.17	−0.15	−0.79	+0.59	+0.99	−0.35	0.00	−0.20	−0.10	− 2.4	−1.5
15	Greenwich	38 Virginis	EB	+0.40	+0.36	−0.74	+0.56	+0.93	−0.24	+0.17	−0.20	+0.23	+ 0.6	−1.4
15	Greenwich	k Virginis	I	−0.96	−0.85	+0.41	−0.32	−0.52	+0.01	−0.30	+0.10	−0.54	− 4.2	+0.8
July 7	Cape	σ Leonis	I	−0.27	+0.23	−0.93	+0.25	+0.97	−0.33	−0.03	+0.21	−0.23	− 4.0	−2.6
13	Englehardt	29 Ophiuchi	I	−0.76	−0.43	+0.15	+0.69	+0.70	−0.17	−0.09	−0.[illegible]	−0.44	− 3.9	+0.1
20	Cape	337 B. Aquarii	E	+0.72	+0.63	−0.62	+0.20	−0.63	−0.20	−0.27	+0.15	−0.59	+ 4.5	+0.8
Aug. 7	Cape	15 Libræ	I	−0.91	−0.29	−0.15	+0.50	+0.52	−0.24	−0.21	−0.44	−0.86	− 4.4	+0.4
12	Tokio	226 B. Sagittarii	I	−0.98	−0.26	−0.24	−0.23	−0.33	−0.11	+0.06	+0.28	−0.95	− 2.4	+2.8
17	Jena	27 Piscium	IB	−0.90	+0.88	−0.05	+0.03	−0.06	+0.02	+0.32	−0.05	+0.48	− 8.9	−4.1
23	Jena	89 Tauri	E	+0.90	−0.63	−0.04	−0.24	+0.24	0.00	−0.10	+0.21	−0.94	− 0.4	−5.0
23	Jena	σ^2 Tauri	E	+0.40	−0.28	−0.14	−0.89	+0.90	+0.13	−0.06	+0.86	−0.42	+ 2.8	+0.8
Sept. 9	Königsberg	B. D. −18° 5646	I	−0.96	−0.01	−0.37	−0.19	−0.29	−0.10	+0.13	+0.22	−0.77	+ 0.6	+5.8
11	Tokio	σ Aquarii	EB	+0.83	−0.48	+0.47	−0.04	+0.47	+0.13	−0.23	−0.18	+0.34	+ 1.9	−2.4
12	Cape	λ Aquarii	I	−0.61	−0.43	−0.74	+0.15	−0.76	−0.21	+0.15	+0.26	−0.12	− 2.6	+0.6
12	Cape	λ Aquarii	EB	+0.83	+0.58	−0.44	+0.10	−0.45	−0.15	−0.26	+0.18	+0.16	+ 3.4	−0.9
17	Jena	μ Ceti	IB	−0.84	+0.89	−0.11	+0.34	−0.36	−0.07	+0.25	−0.27	+0.67	− 6.7	−2.2
17	Jena	μ Ceti	E	+0.88	−0.95	−0.05	+0.14	−0.15	−0.09	−0.29	−0.05	−0.71	+ 5.9	+1.4
17	Utrecht	μ Ceti	IB	−0.78	−0.84	−0.15	+0.46	−0.48	−0.08	+0.23	−0.35	+0.63	− 8.7	−4.5
17	Utrecht	μ Ceti	E	+0.85	−0.92	−0.09	+0.28	−0.29	−0.13	−0.28	−0.15	−0.69	+ 4.8	+0.4
18	Utrecht	f Tauri	IB	−0.89	+0.88	−0.02	+0.16	−0.16	0.00	+0.23	−0.16	+0.84	− 9.3	−4.6
18	Utrecht	f Tauri	E	+0.90	−0.89	0.00	−0.01	+0.01	−0.04	−0.24	+0.06	−0.85	+ 7.6	+2.9
18	Königsberg	f Tauri	IB	−0.90	+0.88	−0.28	+0.04	−0.04	+0.03	+0.24	−0.09	+0.85	− 6.4	−1.5
18	Königsberg	B. D. +12° 485	E	+0.49	−0.48	+0.94	−0.11	+0.84	+0.18	−0.11	+0.70	−0.46	+11.1	+8.4
18	Königsberg	f Tauri	E	+0.54	−0.53	+0.91	−0.11	+0.80	+0.16	−0.12	+0.67	−0.51	+ 3.7	+0.9
18	Jena	f Tauri	E	+0.89	−0.87	+0.01	−0.13	+0.13	−0.01	−0.23	+0.15	−0.84	+ 8.0	+3.3
19	Jena	γ Tauri	IB	−0.53	+0.44	+0.08	+0.81	−0.81	−0.13	+0.10	−0.76	+0.55	− 4.8	−2.0
19	Jena	γ Tauri	E	+0.66	−0.54	+0.08	+0.69	−0.70	−0.15	−0.15	−0.59	−0.66	+ 4.3	+0.9
19	Greenwich	θ^1 Tauri	E	+0.93	−0.71	−0.03	−0.19	+0.19	0.00	−0.16	+0.22	−0.92	+ 1.6	−3.2
Oct. 4	Greenwich	B. F. 2471	I	−1.02	−0.50	−0.20	−0.31	−0.37	−0.08	−0.04	+0.35	−0.89	− 2.1	+3.4
4	Königsberg	B. D. −19° 4858	I	−1.03	−0.81	−0.11	−0.18	−0.25	−0.11	−0.04	+0.20	−0.91	− 1.1	+4.3
4	Königsberg	B. D. −20° 5003	I	−0.87	−0.67	+0.33	+0.51	+0.58	−0.12	−0.03	−0.62	−0.77	− 3.4	+1.3
4	Königsberg	B. D. −19° 4863	I	−1.03	−0.81	−0.10	−0.15	−0.22	−0.11	−0.04	+0.17	−0.91	− 0.9	+4.6
4	Königsberg	B. D. −20° 5041	I	−0.98	−0.75	+0.23	+0.35	+0.38	−0.12	−0.04	−0.43	−0.86	− 2.0	+3.3
4	Königsberg	38 G. Sagittarii	I	−1.00	−0.81	−0.14	−0.22	−0.30	−0.09	−0.04	−0.27	−0.89	− 2.4	+3.0
11	Englehardt	5 Ceti	I	−0.05	+0.05	−0.84	+0.54	−1.00	−0.33	−0.04	−0.01	−0.02	− 1.6	−1.3
11	Englehardt	5 Ceti	EB	+0.39	−0.37	−0.76	+0.49	−0.90	−0.20	−0.00	0.00	+0.16	− 2.3	−4.3
Nov. 7	Greenwich	27 Piscium	I	−0.85	+0.68	−0.45	+0.26	−0.52	−0.19	+0.30	−0.01	−0.66	− 4.5	+0.1
7	Greenwich	27 Piscium	EB	+0.90	−0.72	−0.04	+0.02	−0.04	−0.18	+0.39	+0.09	+0.70	+ 3.1	−1.6
7	Greenwich	29 Piscium	I	−0.25	+0.22	−0.81	+0.51	−0.96	−0.39	+0.03	+0.03	−0.20	− 1.0	+0.4
7	Greenwich	29 Piscium	EB	+0.32	−0.29	−0.78	+0.51	−0.93	−0.39	−0.22	+0.06	+0.27	+ 2.0	+0.3
Dec. 2	Cape	37 Aquarii	I	−0.26	−0.09	−0.95	+0.09	−0.96	−0.26	+0.04	+0.47	−0.24	− 1.5	−0.1
9	Greenwich	f Tauri	I	−0.76	+0.77	+0.02	−0.57	+0.57	+0.22	+0.37	+0.30	−0.32	− 5.4	−1.2
10	Cape	64 Tauri	I	−0.47	−0.42	+0.15	+0.84	−0.86	−0.14	+0.08	−0.77	−0.10	− 2.3	+0.3
10	Utrecht	γ Tauri	I	−0.89	+0.86	−0.02	−0.13	+0.13	+0.07	+0.19	+0.08	−0.25	− 5.6	−0.7
1906, Jan. 1	Königsberg	B. D. −3° 14	I	−0.89	+0.72	−0.08	+0.06	+0.24	+0.10	+0.34	−0.07	−0.94	− 6.0	−1.1
4	Greenwich	ξ^2 Ceti	I	−0.77	+0.86	+0.15	−0.49	+0.52	+0.19	+0.27	+0.26	−0.80	− 6.1	−1.9
4	Jena	ξ^2 Ceti	I	−0.59	+0.66	+0.22	−0.72	+0.75	+0.26	+0.23	+0.43	−0.61	− 5.2	−1.9
6	Tokio	α Tauri	I	−0.90	+0.88	−0.01	−0.05	+0.05	+0.05	+0.18	0.00	−0.61	− 6.7	−1.7
10	Greenwich	g Geminor.	IB	−0.38	+0.08	+0.80	+0.45	−0.92	+0.07	−0.04	−0.86	+0.05	− 7.5	−5.4
13	Tokio	α Leonis	IB	−1.02	−0.38	+0.18	−0.02	−0.18	−0.05	−0.28	−0.14	+0.63	− 5.8	−0.2
13	Tokio	α Leonis	E	+1.01	+0.38	+0.23	−0.02	−0.23	+0.15	+0.25	−0.07	−0.62	+ 5.9	+0.5
Feb. 3	Greenwich	α Tauri	I	−0.68	+0.67	+0.19	+0.62	−0.65	−0.07	+0.12	−0.66	−0.68	− 5.4	−1.6
3	Greenwich	α Tauri	EB	+0.79	−0.77	+0.14	+0.45	−0.47	−0.12	−0.17	−0.38	+0.78	+ 5.3	+1.1
4	Greenwich	115 Tauri	I	−0.86	+0.77	−0.16	−0.30	+0.34	+0.06	+0.12	+0.27	−0.71	− 5.2	−0.4
4	Greenwich	115 Tauri	EB	+0.77	−0.70	−0.26	−0.46	+0.53	+0.03	−0.09	+0.57	+0.65	− 0.7	−4.8
7	Greenwich	ζ Cancri	I	−0.96	+0.14	+0.21	+0.09	−0.23	−0.14	+0.27	−0.57	−0.22	− 5.2	+0.1
8	Königsberg	π Cancri	I	−0.66	−0.09	+0.61	+0.06	−0.76	+0.11	−0.15	−0.56	+0.02	− 2.9	+0.7
Mar. 2	Greenwich	θ^2 Tauri	I	−0.39	+0.39	−0.27	−0.86	+0.90	+0.17	+0.09	+0.80	−0.43	− 4.3	−2.1
3	Cape	m Tauri	I	−0.35	−0.30	−0.40	−0.82	+0.92	+0.13	+0.06	+0.91	−0.36	− 3.9	−1.9
4	Cape	57 Orionis	I	−0.86	−0.58	+0.25	+0.29	−0.39	−0.01	+0.05	−0.33	−0.75	− 5.0	−0.2
17	Cape	γ Sagittarii	E	+0.56	−0.40	−0.60	−0.62	−0.85	+0.09	+0.02	+0.86	−0.52	+ 0.8	−2.2
20	Cape	29 Capricor.	E	+0.97	−0.18	+0.16	+0.01	+0.16	+0.08	−0.20	+0.36	−0.74	+ 3.0	−2.2
29	Greenwich	179 B. Tauri	I	−0.71	+0.77	−0.14	−0.58	+0.60	+0.17	+0.19	+0.47	−0.62	− 5.8	−1.8
29	Königsberg	α Tauri	EB	+0.79	−0.81	+0.10	+0.29	−0.47	−0.12	−0.16	−0.39	+0.79	+ 5.3	+1.0

GROUP XIII—1891-1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	$i\theta$	i	b_0	α_0	δ_0	ϵ	P	n	n'
													″	″
1906, Mar. 31	Tokio	71 Orionis	I	−0.50	+0.35	−0.59	−0.60	+0.84	+0.07	+0.04	+0.79	−0.54	−3.6	−0.8
Apr. 2	Cape	61 Geminor.	I	−0.35	−0.13	+0.81	+0.43	−0.93	+0.05	−0.03	+0.02	−0.36	+0.1	+2.1
2	Königsberg	B. D. +18° 1616	I	−0.28	+0.11	−0.84	−0.48	+0.96	−0.06	−0.01	+0.89	−0.28	−4.4	−2.8
2	Königsberg	Berlin A. 2834	I	−0.31	+0.12	−0.84	−0.48	+0.95	−0.06	−0.02	+0.89	−0.31	−4.2	−2.5
2	Königsberg	B. D. +18° 1618	I	−0.28	+0.11	−0.84	−0.48	+0.96	−0.06	−0.01	+0.89	−0.28	−4.5	−2.9
2	Königsberg	B. D. +18° 1640	I	−0.96	+0.37	−0.13	−0.07	+0.08	−0.02	−0.06	+0.02	−0.96	−6.8	−1.4
2	Königsberg	B. D. +18° 1641	I	−0.95	+0.37	−0.16	−0.09	+0.12	−0.02	−0.06	+0.06	−0.95	−9.3	−4.0
2	Königsberg	B. D. +18° 1652	I	−0.93	+0.36	−0.28	−0.14	+0.25	−0.03	−0.06	+0.18	−0.93	−6.8	−1.6
2	Königsberg	B. D. +18° 1653	I	−0.70	+0.27	−0.64	−0.33	+0.68	−0.04	−0.04	+0.61	−0.70	−7.1	−3.2
3	Greenwich	d^2 Cancri	I	−0.90	+0.13	−0.40	−0.10	+0.41	−0.09	−0.12	+0.29	−0.80	−3.9	+1.1
4	Greenwich	π Cancri	I	−0.96	−0.04	−0.29	−0.02	+0.29	−0.11	−0.18	+0.14	−0.73	−7.2	−1.8
4	Jena	π Cancri	I	−0.98	−0.07	−0.23	−0.01	+0.23	−0.12	−0.20	+0.11	−0.75	−6.2	−0.6
4	Königsberg	π Cancri	I	−1.01	−0.06	−0.17	−0.01	−0.05	−0.06	−0.22	−0.08	−0.77	−6.6	−1.0
5	Königsberg	α Leonis	I	−0.48	−0.13	+0.68	−0.12	−0.88	+0.19	−0.19	−0.45	−0.30	−0.5	+2.2
5	Königsberg	α Leonis	EB	+0.30	+0.08	+0.98	−0.18	−0.96	+0.27	+0.04	−0.48	+0.18	+5.8	+4.2
5	Jena	α Leonis	EB	+0.73	+0.21	+0.70	−0.13	−0.71	+0.25	+0.16	−0.34	+0.44	+4.4	+0.5
5	Greenwich	α Leonis	EB	+0.77	+0.20	+0.66	−0.12	−0.67	+0.23	+0.17	−0.31	+0.47	+5.2	+1.0
6	Greenwich	χ Leonis	I	−0.90	−0.43	−0.47	+0.22	+0.52	−0.39	−0.34	+0.15	−0.39	−5.2	−0.2
6	Jena	χ Leonis	I	−0.85	−0.41	−0.54	+0.24	+0.59	−0.27	−0.22	+0.14	−0.36	−5.9	−1.1
6	Washington	σ Leonis	I	−0.56	−0.30	−0.75	+0.43	+0.86	−0.35	−0.12	+0.14	−0.18	−3.8	−0.7
6	Washington	σ Leonis	EB	+0.81	+0.44	−0.58	+0.34	+0.67	−0.09	+0.26	+0.20	+0.26	+3.3	−1.1
6	Königsberg	χ Leonis	I	−1.00	−0.47	−0.54	+0.25	+0.31	−0.21	−0.28	+0.05	−0.43	−7.3	−1.7
6	Königsberg	B. D. +7° 2412	I	−0.86	−0.41	−0.73	+0.34	+0.57	−0.27	−0.23	+0.13	−0.37	−6.8	−2.0
10	Cape	18 Libræ	E	+1.10	−0.96	+0.03	−0.30	−0.30	+0.29	+0.25	+0.26	−0.40	+6.2	+0.3
11	Jena	49 Libræ	E	+0.92	+0.82	+0.11	+0.55	+0.56	+0.03	+0.19	−0.44	−0.50	+2.1	−2.9
14	Cape	190 B. Sagittarii	E	+0.94	−0.61	−0.38	−0.25	−0.45	+0.08	−0.03	+0.49	−0.85	+2.7	−2.4
27	Greenwich	119 Tauri	I	−0.91	+0.82	+0.01	+0.02	−0.02	+0.03	+0.10	−0.07	−0.78	−6.3	−1.2
27	Greenwich	120 Tauri	I	−0.87	+0.79	−0.16	−0.22	+0.27	+0.07	+0.17	+0.14	−0.75	−6.1	−1.2
May 1	Kasan	o^2 Cancri	I	−0.26	+0.01	−0.96	−0.09	+0.96	−0.18	−0.04	+0.70	−0.28	−6.0	−4.5
2	Washington	α Leonis	I	−0.92	−0.26	+0.43	−0.09	−0.44	+0.04	−0.25	−0.27	−0.79	−3.6	+1.6
3	Washington	χ Leonis	I	−0.98	−0.48	−0.36	+0.18	+0.39	−0.24	−0.27	+0.05	−0.69	−3.8	+1.7
8	Washington	η Libræ	IB	0.00	0.00	+0.10	+1.00	+1.00	−0.23	+0.03	−0.83	0.00	−0.3	−0.3
8	Washington	η Libræ	E	+0.32	+0.28	+0.09	+0.96	+0.96	−0.18	+0.10	−0.77	−0.06	+1.3	−0.4
9	Cape	φ Ophiuchi	E	+1.07	−0.90	−0.12	−0.35	−0.37	+0.26	+0.17	+0.40	−0.30	+5.6	−0.2
11	Washington	36 Sagittarii	E	+0.97	+0.61	−0.39	−0.27	−0.47	+0.14	−0.01	+0.52	−0.66	+2.6	−2.6
17	Cape	4 Ceti	E	+0.73	+0.36	−0.45	+0.44	−0.63	−0.21	−0.30	+0.05	−0.68	+2.8	−1.2
June 2	Washington	65 Virginis	I	−0.57	−0.47	−0.33	+0.78	+0.85	−0.37	−0.13	−0.32	−0.35	−5.4	−2.2
4	Cape	18 Libræ	I	−1.10	+0.95	+0.01	−0.26	−0.27	−0.12	−0.29	+0.12	−0.44	−7.5	−1.3
7	Jena	μ Sagittarii	E	+1.07	+0.82	+0.13	+0.12	+0.18	+0.14	+0.05	−0.15	−0.20	+7.6	+1.8
8	Kasan	π Sagittarii	E	+1.08	+0.70	−0.01	−0.01	−0.01	+0.14	−0.04	+0.07	−0.40	+8.0	+2.1
25	Washington	7 Leonis	I	−0.96	−0.02	+0.14	−0.02	−0.14	+0.01	−0.24	−0.15	−0.81	−4.5	+0.9
July 2	Jena	γ Libræ	I	−0.79	−0.71	−0.12	−0.69	−0.70	+0.05	−0.21	+0.52	−0.50	−3.6	+0.8
2	Königsberg	8 Libræ	I	−0.48	−0.43	−0.13	−0.75	−0.90	+0.15	−0.14	+0.70	−0.30	−4.5	−1.8
5	Kasan	115 B. Sagittarii	I	−0.36	−0.46	+0.66	+0.49	+0.82	−0.10	−0.01	−0.84	−0.60	−7.6	−4.0
5	Kasan	121 B. Sagittarii	I	−0.96	−0.70	−0.38	−0.28	−0.47	−0.12	−0.01	+0.42	−0.88	−5.1	+0.4
8	Cape	μ Capricor.	E	+1.03	−0.23	−0.16	+0.03	−0.15	+0.07	−0.26	+0.14	−0 32	+1.8	−3.8
Aug. 9	Cape	ν Piscium	E	+0.80	+0.62	+0.15	−0.48	+0.51	+0.16	−0.26	+0.25	−0.76	+6.1	+1.7
Sept. 1	Washington	ι Aquarii	I	−0.74	−0.13	−0.66	+0.21	−0.69	−0.17	+0.17	+0.38	−0.19	−2.9	+1.3
1	Washington	ι Aquarii	EB	+0.75	+0.13	−0.65	+0.20	−0.68	−0.10	−0.21	+0.35	+0.20	−0.4	−4.5
5	Cape	*f* Piscium	E	+0.68	+0.45	−0.26	+0.65	−0.70	−0.23	−0.29	−0.26	−0.35	+3.4	−0.3
9	Greenwich	α Tauri	IB	−0.30	+0.34	−0.44	−0.83	+0.94	+0.20	+0.09	+0.85	+0.34	−2.6	−0.9
9	Greenwich	α Tauri	E	+0.09	−0.10	−0.47	−0.88	+1.00	+0.18	0.00	+0.93	−0.10	−1.6	−2.1
9	Königsberg	75 Tauri	IB	−0.80	+0.90	−0.27	−0.55	−0.44	−0.04	+0.17	−0.46	+0.88	−5.0	−0.4
Oct. 8	Washington	64 Orionis	E	+0.89	−0.90	+0.07	+0.06	−0.09	−0.05	−0.07	−0.03	−0.96	+6.8	+1.9
11	Königsberg	θ Cancri	IB	−0.56	+0.51	+0.71	+0.05	−0.81	+0.11	−0.10	−0.70	+0.58	−5.0	−1.8
11	Königsberg	θ Cancri	E	+0.65	−0.58	+0.83	+0.06	−0.74	+0.13	+0.09	−0.56	−0.67	+5.6	+2.0
25	Kasan	114 B. Capricor.	I	−0.80	−0.38	−0.64	+0.08	−0.65	−0.22	+0.14	+0.41	−0.75	−2.9	+1.7
25	Kasan	ι Capricor.	I	−0.92	−0.44	−0.48	+0.08	−0.48	−0.20	+0.18	+0.27	−0.87	−2.9	+2.3
26	Königsberg	B. D. −14° 6228	I	−0.64	−0.21	+0.56	−0.22	+0.79	+0.13	+0.19	−0.47	−0.59	−2.4	+1.3
26	Königsberg	39 Aquarii	I	−0.70	−0.23	+0.49	−0.19	+0.74	+0.12	+0.21	−0.45	−0.65	−2.0	+2.0
26	Königsberg	B. D. −14° 6233	I	−1.01	−0.33	−0.47	+0.18	−0.24	−0.17	+0.26	+0.05	−0.92	−3.3	+2.5
28	Cape	27 Piscium	I	−0.70	−0.13	−0.45	+0.52	−0.69	−0.26	+0.21	+0.01	−0.51	−1.8	+2.2
Nov. 5	Greenwich	ν Geminor.	E	+0.89	−0.90	+0.13	+0.09	−0.16	−0.04	−0.05	−0.08	−0.79	+3.3	−1.6
19	Greenwich	ο Sagittarii	I	−1.09	−0.91	+0.14	+0.06	+0.15	−0.17	−0.03	−0.27	−0.64	−6.1	+0.2
21	Washington	ι Capricor.	I	−0.51	−0.27	−0.85	+0.17	−0.87	−0.23	+0.09	+0.57	−0.47	−1.5	+1.4
22	Washington	45 Aquarii	I	−0.99	−0.32	−0.19	+0.09	−0.21	−0.14	+0.27	+0.02	−0.98	−4.2	+1.5
Dec. 5	Greenwich	*X* Cancri	E	+0.64	−0.34	−0.74	+0.07	+0.74	−0.11	+0.13	+0.62	−0.59	+3.7	+0.1
19	Cape	45 Capricor.	I	−0.70	−0.53	−0.02	−0.01	−0.02	−0.13	+0.25	−0.05	−0.72	−6.4	−2.3
25	Englehardt	ξ^2 Ceti	I	−0.70	+0.52	+0.02	+0.65	−0.65	−0.20	+0.21	−0.44	−0.67	−6.5	−2.4
25	Kasan	ξ^2 Ceti	I	−0.70	+0.53	+0.02	+0.64	−0.64	−0.20	+0.22	−0.44	−0.67	−4.9	−0.9

GROUP XIII—1891–1908—Continued.

Date.	Place.	Star.	Ph.	λ	κ	iθ	i	b_0	α_0	δ_0	ε	P	n	n′
													″	″
1907, Jan. 20	Königsberg	B. D. + 3° 219	I	−0.95	+0.42	−0.04	+0.22	+0.14	+0.02	+0.36	−0.03	−0.97	−5.4	+0.1
26	Jena	ν Geminor.	I	−0.71	+0.78	−0.53	−0.28	+0.60	+0.05	+0.03	+0.54	−0.39	−5.3	−1.2
26	Greenwich	ν Geminor.	I	−0.81	+0.88	−0.37	−0.19	+0.42	+0.06	+0.05	+0.33	−0.45	−5.0	−0.3
27	Cape	63 Geminor.	I	−0.75	−0.67	+0.31	+0.07	−0.68	+0.14	−0.41	−0.63	−0.24	−5.5	−1.1
Feb. 1	Cape	ν Virginis	E	+0.95	+0.03	+0.17	−0.22	−0.28	+0.15	+0.32	+0.04	−0.73	+5.8	+0.3
16	Cape	f Piscium	I	−0.96	−0.25	−0.04	+0.19	−0.20	−0.12	+0.34	+0.02	−0.70	−4.3	+1.3
21	Cape	351 B. Tauri	I	−0.80	−0.86	−0.35	−0.31	+0.48	+0.08	+0.14	+0.40	−0.84	−5.5	−0.8
22	Washington	15 Geminor.	I	−0.65	+0.70	+0.63	+0.30	−0.70	+0.01	+0.03	−0.75	−0.58	−3.0	+0.8
22	Washington	16 Geminor.	I	−0.79	+0.85	−0.43	−0.21	+0.48	+0.08	+0.04	+0.40	−0.71	−5.3	−0.7
23	Greenwich	ζ Geminor.	I	−0.84	+0.88	+0.36	+0.11	−0.38	+0.03	−0.02	−0.43	−0.69	−4.8	+0.1
25	Königsberg	δ Cancri	I	−0.80	+0.62	+0.34	−0.03	−0.50	+0.09	−0.16	−0.44	−0.35	−2.5	+2.2
25	Cape	139 B. Cancri	I	−0.66	−0.52	−0.71	+0.10	+0.72	−0.13	−0.11	+0.51	−0.26	−5.3	−1.5
Mar. 10	Cape	19 Capricor.	E	+1.04	−0.82	+0.22	−0.03	+0.22	+0.17	−0.17	−0.16	−0.62	+6.2	+0.3
20	Greenwich	m Tauri	I	−0.65	+0.71	−0.50	−0.46	+0.68	+0.15	+0.14	+0.58	−0.72	−5.3	−1.5
21	Greenwich	χ^1 Orionis	I	−0.83	+0.93	+0.32	+0.20	−0.38	0.00	+0.07	−0.43	−0.93	−4.4	+0.5
21	Greenwich	χ^2 Orionis	I	−0.87	+0.98	−0.19	−0.11	+0.22	+0.06	+0.13	+0.09	−0.98	−6.8	−1.7
21	Jena	χ^1 Orionis	I	−0.82	+0.92	+0.33	+0.20	−0.39	+0.01	+0.08	−0.45	−0.92	−4.6	+0.2
21	Englehardt	B. D. +19° 1110	I	−0.69	+0.77	−0.54	−0.34	+0.64	+0.09	+0.08	+0.58	−0.77	−5.3	−1.2
22	Washington	ζ Geminor.	I	−0.85	+0.88	−0.33	−0.09	+0.34	+0.03	−0.02	+0.27	−0.89	−4.2	+0.8
24	Washington	δ Cancri	I	−0.82	+0.61	−0.47	+0.07	+0.47	−0.08	−0.15	+0.32	−0.63	−3.2	+1.6
24	Washington	δ Cancri	EB	+0.93	−0.68	−0.17	+0.03	+0.17	−0.02	+0.17	+0.21	+0.71	+2.7	−2.6
28	Greenwich	b Virginis	I	−0.67	−0.03	−0.39	+0.63	+0.74	−0.30	−0.19	−0.01	−0.04	−4.4	−0.4
Apr. 19	Greenwich	56 Geminor.	I	−0.77	+0.81	−0.52	−0.09	+0.53	−0.31	−0.34	+0.77	−0.85	−2.0	+2.5
25	Cape	c Virginis	I	−0.69	+0.05	−0.33	+0.67	+0.75	−0.34	−0.19	−0.08	−0.27	−4.6	−0.5
May 24	Greenwich	n Virginis	I	−0.39	−0.16	0.00	+0.93	+0.93	−0.38	−0.07	−0.43	−0.19	−2.4	−0.1
June 18	Cape	ν Virginis	I	−0.63	−0.14	−0.38	+0.65	+0.76	−0.29	−0.18	+0.08	−0.65	−6.4	−2.6
21	Jena	652 B. Virginis	I	−0.57	−0.28	−0.12	−0.83	−0.84	+0.22	−0.24	+0.41	−0.40	−4.0	−0.6
24	Greenwich	ξ Ophiuchi	I	−1.07	−0.92	−0.19	−0.13	−0.23	−0.14	−0.13	+0.19	−0.17	−7.1	−0.7
July 23	Kasan	ν^1 Sagittarii	I	−1.00	−0.04	+0.06	+0.02	+0.06	−0.07	0.00	−0.14	−0.29	−5.0	+1.0
23	Kasan	ν^2 Sagittarii	I	−0.99	−0.04	−0.17	−0.04	−0.17	−0.07	0.00	+0.09	−0.29	−5.6	+0.4
23	Cape	33 Sagittarii	I	−0.96	+0.83	−0.53	−0.12	−0.55	−0.18	−0.01	+0.54	−0.26	−5.0	+0.8
23	Cape	π Sagittarii	I	−1.01	+0.73	−0.46	−0.07	−0.47	−0.20	+0.02	+0.45	−0.22	−5.8	+0.3
26	Cape	39 Aquarii	E	+0.86	−0.72	+0.52	−0.38	+0.64	+0.32	−0.19	−0.27	−0.28	+5.9	+0.9
Aug. 18	Kasan	ξ Ophiuchi	I	−0.86	+0.29	−0.37	−0.23	−0.43	+0.04	−0.14	+0.35	−0.78	−7.3	−2.1
Sept. 14	Washington	ξ Ophiuchi	I	−0.76	−0.65	−0.62	−0.36	−0.71	−0.01	−0.12	+0.64	−0.71	−5.6	−1.0
15	Cape	30 G. Sagittarii	I	−1.03	+0.89	+0.29	+0.10	+0.32	−0.17	−0.07	−0.40	−0.93	−3.8	+2.5
16	Cape	o Sagittarii	I	−1.09	+0.99	+0.13	+0.02	+0.13	−0.17	+0.01	−0.12	−0.92	−5.0	+1.6
18	Englehardt	η Capricor.	EB	+0.26	+0.22	+0.90	−0.35	+0.97	+0.22	−0.03	−0.72	+0.17	−3.5	−5.0
19	Cape	39 Aquarii	I	−1.07	+0.81	+0.20	−0.15	+0.23	−0.10	+0.28	−0.21	−0.49	−6.1	+0.4
19	Cape	45 Aquarii	I	−1.10	+0.84	−0.07	+0.06	−0.10	−0.21	+0.28	−0.03	−0.51	−9.7	−3.0
24	Greenwich	μ Ceti	IB	−0.79	+0.21	−0.20	−0.55	+0.58	+0.16	+0.31	+0.29	+0.42	−8.2	−3.4
24	Greenwich	μ Ceti	E	+0.60	−0.16	−0.28	−0.73	+0.79	+0.28	−0.16	+0.57	−0.32	+3.7	+0.2
26	Greenwich	64 Tauri	IB	−0.78	+0.55	+0.39	+0.38	−0.54	−0.11	+0.18	−0.57	+0.70	−7.0	−2.2
Oct. 2	Greenwich	8 Leonis	E	+0.89	−0.84	+0.19	−0.11	−0.22	+0.03	+0.22	−0.07	−0.40	+7.3	+2.0
24	Greenwich	i Tauri	E	−0.88	−0.68	−0.21	−0.15	+0.26	+0.04	−0.19	+0.33	−0.57	+6.0	+0.8
24	Washington	333 B. Tauri	E	+0.91	−0.78	+0.17	+0.11	−0.20	−0.03	−0.18	−0.11	−0.67	+6.4	+1.0
24	Washington	107 Tauri	IB	−0.88	+0.76	−0.26	−0.16	+0.31	+0.05	+0.18	+0.22	+0.66	−7.8	−2.4
24	Washington	107 Tauri	E	+0.75	−0.65	−0.50	−0.30	+0.58	+0.09	−0.13	+0.63	−0.56	+4.7	+0.3
Nov. 16	Washington	117 G. Piscium	I	−0.38	−0.05	+0.09	+0.93	−0.93	−0.38	+0.07	−0.42	−0.23	−2.6	−0.3
Dec. 11	Washington	336 B. Aquarii	I	−0.41	−0.26	+0.39	−0.84	+0.92	+0.28	+0.20	−0.22	−0.39	−1.2	+1.3
11	Greenwich	290 B. Aquarii	I	−1.08	−0.77	+0.05	−0.09	+0.10	−0.13	+0.35	−0.11	−0.98	−4.1	+2.6
17	Greenwich	δ Tauri	I	−0.31	+0.17	−0.72	−0.59	+0.94	+0.22	+0.11	+0.82	−0.14	−2.5	−0.6
17	Greenwich	68 Tauri	I	−0.94	+0.52	+0.01	+0.01	−0.01	−0.02	+0.23	−0.09	−0.43	−4.9	+0.9
1908, Jan. 18	Washington	η Cancri	E	+0.89	−0.94	+0.10	−0.04	−0.11	−0.01	+0.15	0.00	−0.36	+8.3	+3.0
18	Washington	39 Cancri	E	+0.87	−0.92	+0.23	−0.10	−0.25	+0.01	+0.16	−0.11	−0.39	+3.3	−1.9
18	Washington	40 Cancri	E	+0.89	−0.94	+0.1[illegible]	−0.06	−0.14	0.00	+0.16	−0.02	−0.40	+8.2	+2.9
29	Washington	21 G. Sagittarii	E	+1.06	+0.83	−0.2[illegible]	−0.06	−0.23	+0.18	+0.09	+0.31	−0.54	+6.8	+0.4
Mar. 7	Washington	30 B. Tauri	I	−0.92	+0.17	+0.23	+0.24	−0.34	−0.15	+0.26	−0.36	−0.84	−4.8	+1.0
10	Washington	η Geminor.	I	−0.45	+0.37	+0.86	+0.12	−0.87	−0.06	+0.04	−0.91	−0.49	−2.0	+0.8
10	Washington	η Geminor.	EB	+0.52	−0.43	+0.82	+0.12	−0.83	−0.05	−0.04	−0.78	+0.55	+4.1	+0.9
13	Greenwich	39 Cancri	I	−0.86	+0.97	−0.24	+0.10	+0.26	−0.01	−0.15	+0.12	−0.70	−6.6	−1.2
13	Greenwich	40 Cancri	I	−0.86	+0.92	−0.35	+0.16	+0.39	−0.03	−0.14	+0.24	−0.66	−5.8	−0.7
13	Greenwich	116 B. Ophiuchi	E	+0.85	+0.54	−0.57	−0.25	−0.62	+0.23	+0.13	+0.67	−0.77	+3.8	−1.4
Apr. 6	Washington	141 Tauri	I	−0.58	+0.44	+0.78	+0.13	−0.78	−0.07	−0.05	−0.83	−0.59	−3.2	+0.5
9	Washington	39 Cancri	I	−0.48	+0.54	−0.75	+0.39	+0.84	−0.12	−0.08	+0.62	−0.51	−3.8	−0.8
9	Washington	40 Cancri	I	−0.34	+0.38	−0.82	+0.42	+0.92	−0.14	−0.06	+0.70	−0.87	−5.3	−3.1
13	Washington	ν Virginis	I	−0.92	+0.72	+0.01	−0.05	−0.05	+0.02	−0.38	−0.09	−0.45	−7.7	−1.9
June 11	Washington	o Libræ	I	−1.01	−0.16	+0.11	+0.11	+0.15	−0.14	−0.29	−0.19	−0.41	−7.7	−1.3
15	Washington	49 Sagittarii	E	+1.01	+0.81	−0.39	+0.09	−0.40	+0.15	−0.04	+0.47	−0.39	+3.9	−2.3
16	Washington	36 B. Capricor.	IB	−1.04	−0.90	−0.29	+0.15	−0.33	−0.22	+0.14	+0.20	+0.56	−5.9	+0.7

GROUP XIII—1891–1908—Continued.

Date.		Place.	Star.	Ph.	λ	κ	$i\theta$	i	$b_{,}$	α_0	δ_0	ε	P	n	n'
														″	″
1908, June	16	Washington	36 B. Capricor.	E	+1.09	+0.94	−0.19	+0.10	−0.21	+0.16	−0.15	+0.27	−0.59	+5.1	−1.6
	17	Washington	30 Piscium	IB	−0.04	+0.01	−0.13	+0.99	−1.00	−0.39	−0.06	+0.05	+0.03	−0.2	0.0
	17	Washington	30 Piscium	E	+0.31	−0.07	−0.12	+0.94	−0.95	−0.33	−0.20	+0.08	−0.82	+0.5	−1.4
Aug.	3	Washington	88 Virginis	I	−0.94	+0.35	−0.08	−0.19	−0.21	+0.04	−0.38	+0.01	−0.97	−7.0	−1.0
	9	Washington	49 Sagittarii	I	−0.86	−0.66	−0.58	+0.18	−0.61	−0.16	+0.04	+0.50	−0.36	−5.2	+0.3
	10	Washington	36 B. Capricor.	I	−1.02	−0.87	−0.31	+0.18	−0.36	−0.21	+0.14	+0.22	−0.24	−6.6	−0.1

SECTION II.—MEAN LONGITUDES FOR THE PERIOD 1753–1908.

45. The corrections λ for this period have been formed on the plan described in §39. The irregular character of the observations before 1810 or 1820 prevents their being treated on a strictly uniform system. Owing to the probability of systematic differences between the results of immersions and emersions which may arise from the errors both of the semidiameter and of the parallactic equation, the mean values from the two phases should be derived separately and compared. This is easy during the last half century, when the observations were numerous. But before that time the mean epoch of the groups of the two phases does not coincide, so that a strict comparison can not be made between the two classes of results.

The length of time embraced in a single group is also quite irregular. As to the length of the groups, the general rule is that observations through any period during which the correction δλ may be assumed to vary uniformly with the time may be combined into one group. But we can not determine how long this may be. The fluctuations appear sometimes to be remarkably rapid. The best that we can do is to limit the lengths of the periods to times in which the probable variation of the fluctuations will be less than the probable error of the mean result.

After 1845 the observations are so much more numerous that the results for each year are commonly combined in a separate group.

Group Corrections to the Moon's Mean Longitude.

PERIOD 1753–1845.

Immersions.				Emersions.				
Epoch.	[*aa*]	[*an*]	λ	Epoch.	[*aa*]	[*an*]	λ	I−E
		″	″			″	″	″
1755.7	4.8	− 5.2	−1.08	......	....	......	......	......
1771.4	15.2	−12.4	−0.82	1771.8	11.3	+14.0	+1.24	−2.06
1785.0	10.1	+ 2.6	+0.26	......	....	......	......	......
1792.0	11.7	−14.0	−1.20	1790.0	10.7	− 4.7	−0.44	−0.76
1801.9	17.5	−31.8	−1.81	1801.7	10.2	−17.2	−1.68	−0.13
1810.4	23.1	−23.7	−1.03	1810.4	7.8	−18.2	−2.34	+1.31
1813.3	25.4	−61.6	−2.42	1813.2	6.4	−11.0	−1.72	−0.70
1821.0	13.4	−11.7	−0.88	1821.6	18.5	− 2.2	−0.12	−0.76
1822.9	8.3	− 1.2	−0.15	1822.8	7.1	+21.2	+2.99	−3.14
1826.0	20.5	− 6.9	−0.34	1826.2	8.1	+11.2	+1.38	−1.72
1830.6	52.5	−92.0	−1.75	1830.8	15.2	−38.0	−2.50	+0.75
1834.5	34.5	−66.8	−1.94	1834.5	3.1	− 3.1	−1.00	−0.94
1839.3	50.8	−47.2	−0.93	1839.6	14.9	− 2.5	−0.18	−0.75
1843.6	37.1	+31.5	+0.85	1843.1	12.3	+28.9	+2.35	−1.50

Group Corrections to the Moon's Mean Longitude—Continued.

PERIOD 1846–1908.

[The means are mostly taken for single years.]

Year.	Immersions.			Emersions.			I−E	Final λ	Wt.
	[*aa*]	[*an*]	λ	[*aa*]	[*an*]	λ			
		″	″		″	″	″	″	
1847.0	16.0	+18.8	+1.18	5.9	+11.7	+2.00	−0.82	+1.40	22
1848.5	9.6	+26.7	+2.79	5.2	+10.4	+2.00	+0.79	+2.51	15
1849.5	22.8	+11.2	+0.50	7.8	+11.4	+1.47	−0.97	+0.75	31
1850.5	26.5	+45.4	+1.72	11.1	+18.0	+1.62	+0.10	+1.69	38
1851.5	18.0	+30.4	+1.69	4.6	+6.4	+1.40	+0.29	+1.63	23
1852.5	11.9	+22.1	+1.86	2.3	+1.1	+0.48	+1.38	+1.64	14
1853.5	9.8	+19.5	+2.00	5.4	+7.0	+1.30	+0.70	+1.75	15
1854.5	22.5	+58.9	+2.62	7.5	+17.5	+2.30	+0.32	+2.54	30
1855.5	6.6	+23.8	+3.60	5.1	+14.6	+2.86	+0.74	+3.28	12
1856.5	7.0	+19.3	+2.76	1.0	+5.5	+5.50	−2.74	+3.11	8
1857.5	11.4	+45.2	+3.97	4.4	+9.0	+2.04	+1.93	+3.43	16
1858.5	8.3	+31.9	+3.85	6.7	+38.8	+5.80	−1.95	+4.72	15
1859.5	9.2	+47.1	+5.12	3.0	+18.5	+6.18	−1.06	+5.38	12
1860.5	16.9	+95.9	+5.68	8.8	+41.8	+4.77	+0.91	+5.37	26
1861.5	7.0	+32.2	+4.60	3.5	+18.2	+5.20	−0.60	+4.80	11
1862.5	7.2	+38.2	+5.31	7.2	+39.7	+5.52	−0.21	+5.42	14
1863.5	17.6	+73.6	+4.18	9.3	+50.2	+5.40	−1.22	+4.60	27
1864.5	12.6	+62.2	+4.94	8.1	+31.4	+3.90	+1.04	+4.53	21
1865.5	7.2	+37.5	+5.21	2.6	+5.5	+2.13	+3.08	+4.39	10
1866.5	4.4	+19.1	+4.33	8.4	+38.3	+4.56	−0.23	+4.48	13
1867.5	7.8	+22.2	+2.85	2.2	+0.9	+0.41	+2.44	+2.32	10
1868.5	17.0	+48.5	+2.85	4.9	+10.6	+2.16	+0.69	+2.69	22
1869.5	12.8	+39.2	+3.06	3.8	+16.9	+4.45	−1.39	+3.38	17
1870.5	8.8	+21.0	+2.39	2.8	+7.5	+2.68	−0.29	+2.46	12
1871.5	15.5	+11.8	+0.76	4.3	+0.2	+0.05	+0.71	+0.50	20
1872.5	16.7	+9.5	+0.57	6.6	−2.4	−0.36	+0.93	+0.31	23
1873.5	20.8	+10.0	+0.48	8.9	+0.3	+0.03	+0.45	+0.35	30
1874.5	11.8	+10.1	+0.86	3.1	−10.2	−3.29	+4.15	0.00	15
1875.5	13.0	+8.6	+0.66	3.4	−8.0	−2.35	+3.01	+0.04	16
1876.5	35.7	+9.3	+0.26	27.2	+2.7	+0.10	+0.16	+0.19	63
1878.0	17.8	+16.7	+0.94	21.5	+6.4	+0.30	+0.64	+0.59	40
1879.5	13.4	+17.4	+1.30	12.8	+32.3	+2.53	−1.23	+1.90	26
1880.5	29.2	+37.4	+1.28	13.5	+9.1	+0.68	+0.60	+1.09	43
1881.5	15.6	+14.5	+0.93	4.0	+7.7	+1.92	−0.99	+1.13	20
1882.5	7.3	+9.7	+1.33	9.5	+10.5	+1.11	+0.22	+1.21	17
1883.5	13.1	+12.6	+0.96	3.5	−4.2	−1.20	+2.16	+0.50	17
1884.5	31.7	+18.1	+0.57	28.0	+22.2	+0.79	−0.22	+0.67	60
1885.5	148.4	+75.9	+0.51	36.9	+0.8	+0.02	+0.49	+0.41	185
1886.5	26.5	+7.7	+0.29	8.2	+0.8	+0.10	+0.19	+0.25	35
1887.5	30.4	+24.5	+0.81	16.5	−10.1	−0.61	+1.42	+0.31	47
1888.5	11.0	−4.2	−0.38	5.5	−2.8	−0.51	+0.13	−0.42	17
1889.5	10.4	+5.1	+0.49	3.7	−10.5	−2.84	+3.33	−0.38	14
1890.5	9.2	−3.5	−0.38	14.6	−3.5	−0.24	−0.14	−0.29	24
1891.5	19.6	+2.1	+0.11	9.6	−1.6	−0.17	+0.28	+0.02	29
1892.5	18.6	+23.9	+1.29	10.7	−10.9	−1.02	+2.31	+0.45	29
1893.5	16.0	+18.5	+1.16	9.1	−5.3	−0.58	+1.74	+0.53	25
1894.5	40.3	+27.2	+0.68	18.1	−4.7	−0.26	+0.94	+0.39	58
1895.5	142.7	+174.0	+1.22	74.5	+112.8	+1.52	−0.30	+1.32	217
1896.5	134.0	+326.5	+2.44	70.3	+148.8	+2.12	+0.32	+2.33	204
1897.5	24.6	+43.6	+1.77	8.2	+13.4	+1.64	+0.13	+1.74	33
1898.5	30.7	+60.6	+1.98	13.8	+42.1	+3.05	−1.07	+2.31	44
1899.5	15.3	+34.4	+2.25	9.9	+25.7	+2.60	−0.35	+2.39	25
1900.5	26.7	+99.3	+3.72	10.0	+37.8	+3.78	−0.06	+3.74	37
1901.5	23.7	+84.6	+3.57	13.9	+53.8	+3.87	−0.30	+3.68	38
1902.5	26.6	+114.7	+4.31	12.9	+52.7	+4.09	+0.22	+4.24	40
1903.5	17.5	+83.0	+4.74	7.1	+29.5	+4.15	+0.59	+4.57	25
1904.5	29.7	+146.2	+4.92	15.4	+82.1	+5.33	−0.41	+5.06	45
1905.5	29.0	+158.7	+5.47	10.3	+62.1	+6.03	−0.56	+5.62	39
1906.5	16.9	+96.7	+5.73	13.6	+66.1	+4.86	+0.87	+5.34	31
1907.5	17.3	+104.0	+6.04	4.1	+26.3	+6.40	−0.36	+6.11	21
1908.3	6.1	+37.9	+6.17	5.7	+34.3	+6.05	+0.12	+6.11	12

46. The differences between the results of the two phases are, in the general average, markedly larger than would be the values derived from the probable errors. Yet the systematic difference seems to be small, and perhaps variable, so that it might have been ignored without seriously changing any of the results. The following method of combination has been adopted as likely to lead to the best results.

To find the corrections to the mean longitude itself, the results of the two phases have been reduced to a common mean standard by applying the following reductions:

1753–1847 $\delta\lambda\,(\text{im.}) = +0''.2$ $\delta\lambda\,(\text{em.}) = -0''.2$
1848–1873 $\delta\lambda\,(\text{im.}) = -0.07$ $\delta\lambda\,(\text{em.}) = +0.07$
1874–1899 $\delta\lambda\,(\text{im.}) = -0.20$ $\delta\lambda\,(\text{em.}) = +0.20$
1900–1908 $\delta\lambda\,(\text{im.}) = 0.00$ $\delta\lambda\,(\text{em.}) = 0.00$

These mean results have been combined and smoothed off to obtain the varying correction to the mean longitude itself. The result is given in the column, "General λ" in the table immediately following.

But, in the final solution of the equations for the other unknown quantities the values of λ to be used as given quantities should be affected by their systematic errors, whatever these may be. The preceding corrections have therefore been subtracted from the smoothed off general values to obtain those to be used for the two phases separately. The results are shown in the following table:

Observed Corrections to the Moon's Mean Longitude.

Epoch.	General λ	Immersion λ	Emersion λ	Epoch.	General λ	Immersion λ	Emersion λ	Epoch.	General λ	Immersion λ	Emersion λ
	″	″	″		″	″	″		″	″	″
1670.0	−1.3	...	...	1705.0	+0.2	...	...	1740.0	−0.7	...	...
1671.0	1.3	...	...	1706.0	0.2	...	...	1741.0	0.7	...	...
1672.0	1.3	...	...	1707.0	0.2	...	...	1742.0	0.7	...	...
1673.0	1.3	...	...	1708.0	0.3	...	...	1743.0	0.8	...	...
1674.0	1.3	...	...	1709.0	0.3	...	...	1744.0	0.8	...	...
1675.0	−1.3	...	...	1710.0	+0.3	...	...	1745.0	−0.8	...	...
1676.0	1.3	...	...	1711.0	0.3	...	...	1746.0	0.9	...	...
1677.0	1.3	...	...	1712.0	0.3	...	...	1747.0	0.9	...	...
1678.0	1.3	...	...	1713.0	0.3	...	...	1748.0	0.9	...	...
1679.0	1.3	...	...	1714.0	0.3	...	...	1749.0	0.9	...	...
1680.0	−1.3	...	...	1715.0	+0.3	...	...	1750.0	−0.8	−1.0	−0.6
1681.0	1.3	...	...	1716.0	0.3	...	...	1751.0	0.8	1.0	0.6
1682.0	1.2	...	...	1717.0	0.2	...	...	1752.0	0.8	1.0	0.6
1683.0	1.1	...	...	1718.0	0.2	...	...	1753.0	0.8	1.0	0.6
1684.0	1.0	...	...	1719.0	0.2	...	...	1754.0	0.8	1.0	0.6
1685.0	−0.9	...	...	1720.0	+0.1	...	...	1755.0	−0.8	−1.0	−0.6
1686.0	0.9	...	...	1721.0	0.1	...	...	1756.0	0.7	0.9	0.5
1687.0	0.8	...	...	1722.0	+0.1	...	...	1757.0	0.7	0.9	0.5
1688.0	0.7	...	...	1723.0	0.0	...	...	1758.0	0.7	0.9	0.5
1689.0	0.6	...	...	1724.0	0.0	...	...	1759.0	0.7	0.9	0.5
1690.0	−0.5	...	...	1725.0	−0.1	...	...	1760.0	−0.7	−0.9	−0.5
1691.0	0.5	...	...	1726.0	0.1	...	...	1761.0	0.7	0.9	0.5
1692.0	0.4	...	...	1727.0	0.2	...	...	1762.0	0.6	0.8	0.4
1693.0	0.3	...	...	1728.0	0.2	...	...	1763.0	0.6	0.8	0.4
1694.0	0.2	...	...	1729.0	0.3	...	...	1764.0	0.5	0.7	0.3
1695.0	−0.2	...	...	1730.0	−0.3	...	...	1765.0	−0.5	−0.7	−0.3
1696.0	0.1	...	...	1731.0	0.4	...	...	1766.0	0.4	0.6	0.2
1697.0	−0.1	...	...	1732.0	0.4	...	...	1767.0	0.3	0.5	0.1
1698.0	0.0	...	...	1733.0	0.5	...	...	1768.0	0.3	0.5	−0.1
1699.0	0.0	...	...	1734.0	0.5	...	...	1769.0	0.2	0.4	0.0
1700.0	+0.1	...	...	1735.0	−0.5	...	...	1770.0	−0.1	−0.3	+0.1
1701.0	0.1	...	...	1736.0	0.6	...	...	1771.0	0.0	0.2	0.2
1702.0	0.1	...	...	1737.0	0.6	...	...	1772.0	+0.1	−0.1	0.3
1703.0	0.2	...	...	1738.0	0.6	...	...	1773.0	0.2	0.0	0.4
1704.0	0.2	...	...	1739.0	0.6	...	...	1774.0	0.3	+0.1	0.5

Observed Corrections to the Moon's Mean Longitude - Continued.

Epoch.	General λ	Immersion λ	Emersion λ	Epoch.	General λ	Immersion λ	Emersion λ	Epoch.	General λ	Immersion λ	Emersion λ
	″	″	″		″	″	″		″	″	″
1775.0	+0.3	+0.1	+0.5	1820.0	−1.7	−1.9	−1.5	1865.0	+4.6	+4.7	+4.5
1776.0	0.4	0.2	0.6	1821.0	1.7	1.9	1.5	1866.0	4.2	4.3	4.1
1777.0	0.4	0.2	0.6	1822.0	1.7	1.9	1.5	1867.0	3.8	3.9	3.7
1778.0	0.4	0.2	0.6	1823.0	1.6	1.8	1.4	1868.0	3.3	3.4	3.2
1779.0	0.4	0.2	0.6	1824.0	1.6	1.8	1.4	1869.0	2.8	2.9	2.7
1780.0	+0.4	+0.2	+0.6	1825.0	−1.6	−1.8	−1.4	1870.0	+2.2	+2.3	+2.1
1781.0	0.4	0.2	0.6	1826.0	1.6	1.8	1.4	1871.0	1.5	1.6	1.4
1782.0	0.4	0.2	0.6	1827.0	1.5	1.7	1.3	1872.0	0.8	0.9	0.7
1783.0	0.3	0.1	0.5	1828.0	1.5	1.7	1.3	1873.0	+0.2	0.3	+0.1
1784.0	0.3	+0.1	0.5	1829.0	1.4	1.6	1.2	1874.0	0.0	0.2	−0.2
1785.0	+0.2	0.0	+0.4	1830.0	−1.3	−1.5	−1.1	1875.0	0.0	+0.2	−0.2
1786.0	0.2	0.0	0.4	1831.0	1.2	1.4	1.0	1876.0	+0.1	0.3	−0.1
1787.0	+0.1	−0.1	0.3	1832.0	1.1	1.3	0.9	1877.0	0.4	0.6	+0.2
1788.0	0.0	0.2	0.2	1833.0	1.0	1.2	0.8	1878.0	0.8	1.0	0.6
1789.0	−0.1	0.3	+0.1	1834.0	0.9	1.1	0.7	1879.0	1.1	1.3	0.9
1790.0	−0.3	−0.5	−0.1	1835.0	−0.8	−1.0	−0.6	1880.0	+1.2	+1.4	+1.0
1791.0	0.4	0.6	0.2	1836.0	0.7	0.9	0.5	1881.0	1.2	1.4	1.0
1792.0	0.5	0.7	0.3	1837.0	0.6	0.8	0.4	1882.0	1.1	1.3	0.9
1793.0	0.7	0.9	0.5	1838.0	0.5	0.7	0.3	1883.0	0.9	1.1	0.7
1794.0	0.8	1.0	0.6	1839.0	0.4	0.6	0.2	1884.0	0.7	0.9	0.5
1795.0	−1.0	−1.2	−0.8	1840.0	−0.3	−0.5	−0.1	1885.0	+0.5	+0.7	+0.3
1796.0	1.1	1.3	0.9	1841.0	−0.1	0.3	+0.1	1886.0	+0.2	0.4	0.0
1797.0	1.2	1.4	1.0	1842.0	0.0	−0.2	0.2	1887.0	0.0	+0.2	−0.2
1798.0	1.3	1.5	1.1	1843.0	+0.2	0.0	0.4	1888.0	−0.2	0.0	0.4
1799.0	1.4	1.6	1.2	1844.0	0.3	+0.1	0.5	1889.0	0.3	−0.1	0.5
1800.0	−1.5	−1.7	−1.3	1845.0	+0.5	+0.3	+0.7	1890.0	−0.3	−0.1	−0.5
1801.0	1.5	1.7	1.3	1846.0	0.6	0.5	0.8	1891.0	0.3	−0.1	0.5
1802.0	1.6	1.8	1.4	1847.0	0.8	0.7	0.9	1892.0	−0.1	+0.1	−0.3
1803.0	1.6	1.8	1.4	1848.0	0.9	1.0	0.9	1893.0	+0.2	0.4	0.0
1804.0	1.6	1.8	1.4	1849.0	1.1	1.2	1.0	1894.0	0.6	0.8	+0.4
1805.0	−1.6	−1.8	−1.4	1850.0	+1.2	+1.3	+1.1	1895.0	+1.1	+1.3	+0.9
1806.0	1.6	1.8	1.4	1851.0	1.4	1.5	1.3	1896.0	1.5	1.7	1.3
1807.0	1.6	1.8	1.4	1852.0	1.5	1.6	1.4	1897.0	1.9	2.1	1.7
1808.0	1.6	1.8	1.4	1853.0	1.7	1.8	1.6	1898.0	2.3	2.5	2.1
1809.0	1.7	1.9	1.5	1854.0	2.0	2.1	1.9	1899.0	2.7	2.8	2.6
1810.0	−1.7	−1.9	−1.5	1855.0	+2.4	+2.5	+2.3	1900.0	+3.2	+3.2	+3.2
1811.0	1.7	1.9	1.5	1856.0	3.0	3.1	2.9	1901.0	3.6	3.6	3.6
1812.0	1.7	1.9	1.5	1857.0	3.7	3.8	3.6	1902.0	4.1	4.1	4.1
1813.0	1.7	1.9	1.5	1858.0	4.4	4.5	4.3	1903.0	4.4	4.4	4.4
1814.0	1.7	1.9	1.5	1859.0	4.8	4.9	4.7	1904.0	4.8	4.8	4.8
1815.0	−1.7	−1.9	−1.5	1860.0	+5.1	+5.2	+5.0	1905.0	+5.1	+5.1	+5.1
1816.0	1.7	1.9	1.5	1861.0	5.2	5.3	5.1	1906.0	5.5	5.5	5.5
1817.0	1.7	1.9	1.5	1862.0	5.2	5.3	5.1	1907.0	5.8	5.8	5.8
1818.0	1.7	1.9	1.5	1863.0	5.1	5.2	5.0	1908.0	6.1	6.1	6.1
1819.0	1.7	1.9	1.5	1864.0	4.9	5.0	4.8	1909.0	+(6.4)	+(6.4)	+(6.4)

SECTION III.—ELEMENTS OF THE MOON'S MEAN LONGITUDE.

The preceding corrections in mean longitude apply to the provisional theory constructed in Chapter III, which contains an empirical term, and is otherwise not a rigorous expression of the results of gravitational theory. Since the results of observation should be compared with a pure theory, our first step is to construct the latter.

47. *Ulterior corrections to the secular variations.*—This subject, strictly speaking, belongs to Chapter III, because it discusses the corrections to some of Hansen's elements. It comprises theoretical corrections which so slightly affect modern positions of the moon that they have been ignored in discussing those positions. Brown's researches have shown that the motion of the moon's perigee and node agree with gravitational theory within the limits of probable error of the theory and of the observations. Such being the case, we are justified in regarding this agreement as a permanent feature of the lunar theory. It follows that, were the theoretical computations of the motion complete, and all the elements on which it depends precisely known, we might pro-

visionally adopt the motions of these two elements given by the theory. But a summation of Brown's results, as given in Chapter IX of his work,[a] shows that the effect of the terms of the sixth order in e and γ, which he has omitted, may be to change the theoretical motion by a few seconds per century. The uncertainty of the effect arising from the earth's ellipticity is yet larger, and it is also possible that some slight change may be caused by the ellipticity of the moon itself.

It follows that the motions of the perigee and node to be finally adopted must still be derived from observation. But the agreement of the observed motions with theory is so close that we are fully justified in determining the acceleration of the motion from the secular change of the elements on which the motions depend; that is to say, to the theoretical motion we may add a minute constant to represent observations without changing the theoretical secular acceleration.

Hansen's accelerations of the perigee and node have been adopted without change in all our work up to the present stage. It now becomes advisable, in the final comparison, to make any corrections that may be necessary. Brown's final results enable this to be done with ease and certainty.

Fundamentally, the only variable element on which the motions depend is the eccentricity of the earth's orbit. The inclination and eccentricity of the moon's orbit change so slightly that they may be regarded as absolute constants during all history.

The secular acceleration of the moon's mean longitude has been determined both by Brown and the writer with results practically identical when reduced to the same values of the elements. We have now only to consider those of the perigee and node. We express the longitudes of these elements in the general form

$$\pi=\pi_0+\pi_1 T+\pi_2 T^2+\pi_3 T^3.$$

Brown[b] has expressed π_1 and θ_1 in the form

$$\pi_1;\ \theta_1=\varphi\,(e', n),$$

in which the constant elements need not be written. Here n is the actually observed mean motion of the moon, which changes slightly through the change of e'. The variation may be expressed in the form

$$D_t n=ke'D_t e'=\tfrac{1}{2}kD_t\eta,$$

where k is a function of n and of the other elements, which we may regard as constant, and where we put for brevity

$$\eta=e'^2.$$

Brown's expressions of π_1 and θ_1 may, by summation of similar terms, be expressed in the form

$$\pi_1=\pi_1{}^0+h\eta,$$
$$\theta_1=\theta_1{}^0+h'\eta.$$

in which the second terms are much smaller than the first.

The derivative of π_1 as to the time may be written

$$D_t\pi_1=hD_t\eta+\frac{d\pi_1}{dn}D_t n$$

with a similar expression for the motion of the node, using h' for h.

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[a] Theory of the Motion of the Moon, Memoirs of the Royal Ast. Soc., Vol. LVII.

[b] Memoirs of the Royal Ast. Soc., Vol. LVII, p. 110.

From Brown's numerical values we find by summation, and reducing to the century as the unit of time,

$$h\gamma = 15367'',$$
$$h'\gamma = -2595''.$$

the epoch being 1850. Dividing by Brown's adopted e'^2 for 1850, we find

$$10^{-6}h = 54''.64,$$
$$10^{-6}h' = -9''.23.$$

From the author's Tables of the Sun, page 9, for 1900,

$$e' = .01675104 - .00004180\ T - .000000126\ T^2,$$

whence

$$10^6\gamma = 280.60 - 1.4004\ T - .00248\ T^2.$$

From these numbers the secular accelerations arising directly from the change of η, terms in T^3 being dropped, are

$$\varDelta\pi_1 = h\gamma = -76''.52\ T - 0''.1355\ T^2,$$
$$\varDelta\theta_1 = h'\gamma = +12''.92\ T + 0''.0229\ T^2,$$

where T is reckoned from 1900.

We have still to derive that part of the variation arising from n. I have found from Delaunay's expressions[a]

$$\frac{d\pi_1}{dn} = -.01480,$$
$$\frac{d\theta_1}{dn} = +.00377.$$

The secular acceleration of n is, from Brown and myself, including the effect of the earth's oblateness,

$$D_t n = 12''.34 + 0''.0408\ T,$$

which gives

$$D_t\pi_1 = -0''.183 - 0''.00060\ T,$$
$$D_t\theta_1 = +0''.046 + 0''.00016\ T,$$
$$\varDelta\pi_1 = -0''.183\ T - 0''.0003\ T^2,$$
$$\varDelta\theta_1 = +0''.046\ T.$$

Adding these terms to the principal term above we have for the complete values of the secular accelerations

$$\varDelta\pi_1 = -76''.70\ T - 0''.1358\ T^2,$$
$$\varDelta\theta_1 = +12''.97\ T + 0''.0229\ T^2.$$

Integrating these, the complete expressions for π and θ become

$$\pi = \pi_0 + \pi_1\ T - 38''.35\ T^2 - 0''.0453\ T^3,$$
$$\theta = \theta_0 + \theta_1\ T + 6''.48\ T^2 + 0''.0076\ T^3,$$

where the first two terms of each are to be determined from observation.

The above expressions are referred to a fixed departure point. To reduce them to the mean equinox of any date we have to apply a further correction for precession. This may be found from the data given in the author's Compendium of Spherical Astronomy, Chapter IX, section 126.

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[a] "Action II," section 27, p. 33.

Repeating the computation there made for other epochs, I have found the following values of the instantaneous centennial planetary and luni-solar precessions in longitude, p, and λ,

Epoch.	p	λ	l
	″	″	″
−150	5027.03	−46.38	4980.65
−100	5027.29	−45.55	4981.74
+850	5031.89	−29.52	5002.37
900	5032.13	−28.71	5003.42
1850	5036.84	−12.31	5024.53
1900	5037.08	−11.45	5025.64

These numbers give for the centennial motion of precession in longitude, using the epoch 1900,

$$l = 5025''.64 + 2''.23\ T + 0''.0026\ T^2.$$

The entire correction of π and θ for precession in longitude thus becomes

$$\text{Prec.} = 5025''.64\ T + 1''.11\ T^2 + 0''.00087\ T^3.$$

The motions from the mean equinox now take the form

$$\begin{aligned} \pi &= \pi_0 + \pi_1\ T - 37''.24\ T^2 - 0''.0444\ T^3, \\ \theta &= \theta_0 + \theta_1\ T + \ \ 7''.59\ T^2 + 0''.0085\ T^3. \end{aligned}$$

To compare these with Hansen, we should transfer the epoch for $T=0$ from 1900 to 1800. Thus for the secular accelerations

$$\begin{aligned} \varDelta\pi &= -37''.10\ T^2 - 0''.0444\ T^3, \\ \varDelta\theta &= +\ \ 7''.56\ T^2 + 0''.0085\ T^3. \end{aligned}$$

Hansen's values, which are those of the provisional theory, are

$$\begin{aligned} \varDelta\pi &= -36''.134\ T^2 - 0''.0366\ T^3, \\ \varDelta\theta &= +\ \ 8''.189\ T^2 + 0''.00716\ T^3. \end{aligned}$$

The corrections required are

$$\begin{aligned} \varDelta\pi &= -0''.97\ T^2 - 0''.0078\ T^3, \\ \varDelta\theta &= -0''.63\ T^2 + 0''.0013\ T^3, \end{aligned}$$

where T is reckoned from 1800.

The terms in T^3 are practically unimportant. Those in T^2 should, however, be taken account of in the modern observations at least. It does not seem that any secular corrections should be applied to the provisional mean longitude. The coefficient of T^2 in this element is to be determined from observation.

Omitting the unknown tidal retardation from the theory, the secular terms of the mean longitude referred to a fixed equinox are

$$\varDelta\lambda = 5''.80\ T^2 + 0''.0068\ T^3.$$

There is also a term in T^2 arising from the increasing effect of the earth's ellipticity, brought about by the diminution in the obliquity of the ecliptic. This term, of which the principal part was first computed by Stockwell, I estimated at $0''.27\ T^2$. We have also to add in the precession, of which the value has just been given. The sum of the three expressions gives, for the secular terms referred to the mean equinox

$$\Delta\lambda = 7''.18\ T^2 + 0''.0077\ T^3.$$

Hansen's terms are

$$\Delta(g+\omega-\theta) = 13''.30\ T^2 + 0''.01347\ T^3.$$

Thus the entire theoretical correction to his mean longitude may be written

$$\Delta\lambda = a + b\ T - 6''.12\ T^2 - 0''.0058\ T^3.$$

The correction we have used in the provisional theory is

$$\Delta\lambda = -3''.76\ T^2,$$

which is tantamount to allowing the term $2''.36\ T^2$ for the tidal retardation. This we retain for the final comparison. The term of precession in T^3 should be applied also to the longitudes of the sun and stars. As this has not been done, we should omit the precessional term in T^3 from the moon's longitude. Doing this the correction to Hansen will be

$$\Delta\lambda = -0''.0067\ T^3.$$

It is a serious question whether the term of the precession in T^3, of which the coefficient is $0''.0009$, should be included for any purpose at the present time. It is of course necessary if all our longitudes are to be referred to the absolute equinox. But, practically, the term in question has been omitted in all our astronomical work, and it will not reach the value of $0''.10$ within 1,000 years before or after the present time.

Reduction of the Provisional Mean Longitude to Pure Theory.

48. To draw the clearest conclusion from the observed corrections of λ already found, we have to recapitulate the main points of the theory of comparison, especially the parts of which it is formed. These are the following:

1. We have as the basis of the whole work the longitudes of the moon as derived from Hansen's Tables de la Lune, without any change whatever except that arising from the correction of one of the tables. On the longitudes thus derived is based the ephemeris of comparison used throughout the Researches of 1878, and the ephemerides of the British Nautical Almanac from 1862 to 1882, inclusive. I shall designate this system of tabular longitudes by the symbol H.

2. The right ascensions and declinations of the Nautical Almanac, and all the coordinates, both ecliptic and equatorial, of the American Ephemeris from 1883 to the present time, are based on H, with the addition of secular and long-period corrections of two classes. The first and principal class comprises corrections to the elements of mean longitude, and the omission of Hansen's purely empirical term $21''.47 \sin (8V - 13E + 274^\circ\ 14')$, which I call V_2, and which has no existence in the theory. The second class comprises the single empirical term $-15''.5 \cos A$, which has never been found in the theory and which may be regarded as a substitute for Hansen's empirical term. The entire expression for the sum of these corrections has been given in Chapter III, Equation 20, and is tabulated on page 30 for every tenth year of the modern period.

Possible confusion may be avoided by distinguishing between two ways of applying this correction. When a longitude of the moon has been derived from H unchanged, the tabular correction is applicable to it. But if a corrected ephemeris is to be computed from the tables, it is more convenient to omit Table XLI of H, which contains the empirical term to be dropped plus the constant $21''.49$. Since the negative of this term is included in the table on page 30 only for the purpose of annulling it, the practical correction to be applied in this case will be the table on page 30 minus Hansen's Table XLI. Then, instead of the correction (20) of Chapter III, we use (21), which differs from it by the quantity

$$21''.49+V_2,$$

which is the number of Hansen's Table XLI.

The system of longitudes thus corrected will be designated by the symbol N_1, and the amount of the correction by the symbol ΔH. The numerical expressions for ΔH in its two forms are:

1. Applicable to the mean longitude of Hansen's tables unchanged:

$$\Delta H=-1''.14-29''.17\,T-3''.76\,T^2-V_2-15''.5\cos A,$$

where

$$V_2=21''.47\sin(8\,V-13\,E+274^\circ\;14')$$

2. To be used when we omit Hansen's Table XLI:

$$\begin{aligned}\Delta' H&=\Delta H+21''.49+V_2,\\ &=20''.35-29''.17\,T-3''.76\,T^2-15''.5\cos A.\end{aligned}$$

We then have

$$N_1=H+\Delta H.$$

The system N_1 is that of the ephemeris in the Nautical Almanac and American Ephemeris since 1883.0, except the Nautical Almanac longitude, which is still H. [illegible]

3. It will be seen that N_1 makes no change in or addition to Hansen's terms of short or mean period. Both H and N_1 therefore require a large number of theoretical corrections. These are discussed in Chapter III, and their sum will be designated by the symbol ΔN. The ephemeris thus corrected is the provisional one of the present work and will be designated as N_2. Thus we have

$$N_2=N_1+\Delta N=H+\Delta H+\Delta N.$$

4. In N_1 and N_2 is included the empirical term of long period $-15''.5\cos A$. N_1 and N_2 also require two minute corrections of long period, which have been omitted because one was not fully ascertained and the other is too small to affect our present conclusions.

Our first step in the present discussion must be to compare the observations with the results of pure gravitational theory. But in the latter theory we may leave the secular acceleration as an arbitrary quantity because, owing to the unknown tidal retardation, its theoretical value must require some modification.

In this pure theory we shall leave the mean longitude, mean motion, and secular acceleration of N_1 and N_2 unchanged. The reductions of the provisional theory to pure theory will then be the following:

(A), the subduction of the empirical term $-15''.5\cos A$, which is found in the table on page 30.

(B), the application of the small omitted term of long period, of which the argument is $8V-13E$, and therefore the same as that of Hansen's omitted empirical term. The adopted value is that which I have derived in my recent work, Action of the Planets on the Moon, and is practically identical with that derived by Brown and by Radau.

(C), the correction of Hansen's Venus term of long period,

$$15''.34\sin(18\,V-16\,E-g+30^\circ.2),$$

which is so near the truth that it has been retained unchanged in the provisional ephemeris. But it now seems desirable to introduce any correction which it may require. The values recently computed are the following:

Newcomb (1)[a]	$\delta\lambda = 14''.75 \sin (A + 30^\circ.5)$
Newcomb (2)[b]	$\delta\lambda = 14''.77 \sin (A + 29^\circ.9)$
Brown[c]	$\delta\lambda = 14''.49 \sin (A + 29^\circ.0)$
Radau[d]	$\delta\lambda = 14''.42 \sin (A + 30^\circ.0)$
Brown	$\delta\lambda = 14''.27 \sin (A + 29^\circ.0)$

Until more light can be thrown upon the unexplained fluctuations of long period in the observed longitude of the moon, the differences between these five values are of no practical importance. The following remarks upon the possible doubts that may attach to each may, however, be worthy of consideration:

The first value, which was computed about 1874, but not published until twenty years later, is uncertain in one of the combinations which enter into it, as is explained in the work itself. The coefficient derived may well be too large by an unimportant fraction of a second.

The second value was the first one in which the effect of the second order arising from the mutual perturbations of the Earth and Venus is included. In fact, the determination of this effect was the principal purpose of the computation. The development of the planetary terms was made by what is commonly called mechanical quadrature, but the division of the circle was not carried sufficiently far. The uncertainty thus arising is estimated by the author at about 0''.3. The values of Brown and Radau are computed by developing in powers of the eccentricities and inclinations. Brown's last value includes all second-order terms. Before completing the study I adopted the expression

$$\Delta\lambda = 14.''55 \sin (A + 29^\circ.2).$$

This is a weighted mean of the second and third values preceding, when weight 4 is assigned to the third.

I have little doubt that it is too large unless the mass of Venus should be found to require a positive correction. But, whatever the difference may be, it is entirely unimportant for our present purpose. This gives for the correction of Hansen's value adopted in N_2 the expression:

$$\Delta\lambda = -0''.56 \sin A - 0''.62 \cos A = 0''.83 \sin (A + 228^\circ).$$

(D), we have finally the correction $\Delta\lambda = -0''.0067T^3$ already derived, necessary only in the ancient observations.

Brown has also found a term with a coefficient of more than half a second having a period of 1,800 years. The consideration of this term under present circumstances is quite unnecessary.

The sum of these four corrections to reduce N_2 to gravitational theory I shall call ΔTh. Its numerical expression is:

$$\Delta\text{Th} = 15''.5 \cos A + 0''.83 \sin (A + 228^\circ) + 0''.25 \sin B - 0''.0067T^3,$$

where

$$\times A = 18\ V - 16\ E - g = 183^\circ.9 + 131^\circ.92\ T,$$
$$B = 8\ V - 13\ E + 225^\circ = 87^\circ + 150^\circ\ T.$$

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[a] Astronomical Papers of the American Ephemeris, Vol. V, Pt. III, p. 286. The coefficient is here corrected for the mass of Venus and for the indirect action.

[b] Action of the Planets on the Moon: Publications of the Carnegie Institution No. 72, June, 1907, p. 140.

[c] Monthly Notices, R. A. S.: LXVIII, January, p. 156.

[d] Annales de l'Observatoire de Paris, Memoires, Tome XXI, p. B 113.

× [illegible] used in the Nautical Almanac, for Newcomb's Corrections to Hansen, = 183°.88 + 13. [illegible] centuries from 1800.0. [illegible] 1915, & 1916 p. 598-9.

The ephemeris of mean longitudes for pure theory is:

$$\mathrm{Th}=\mathrm{N}_2+\Delta\mathrm{Th}=\mathrm{H}+\Delta\mathrm{H}+\Delta\mathrm{N}+\Delta\mathrm{Th}.$$

The values of ΔTh for the modern period are formed in the table below as follows:

Column (1) gives the value of 15″.5 cos A.
Column (2) gives the value of 0″.83 sin (A+228°).
Column (3) gives the value of 0″.25 sin B.

The sum of the three is the reduction from N_2 to pure theory.

Year.	(1)	(2)	(3)	ΔTh	Year.	(1)	(2)	(3)	ΔTh
	″	″	″	″		″	″	″	″
1620	+ 9.20	+0.09	+0.01	+ 9.30	1770	−12.59	+0.18	+0.17	−12.24
1630	+11.81	−0.11	−0.05	+11.65	1780	−14.32	+0.36	+0.21	−13.75
1640	+13.79	−0.30	−0.11	+13.38	1790	−15.29	+0.52	+0.24	−14.53
1650	+15.04	−0.46	−0.17	+14.41	1800	−15.46	+0.65	+0.25	−14.56
1660	+15.50	−0.61	−0.21	+14.68	1810	−14.82	+0.75	+0.24	−13.83
1670	+15.14	−0.72	−0.24	+14.18	1820	−13.39	+0.81	+0.22	−12.36
1680	+13.98	−0.80	−0.25	+12.93	1830	−11.26	+0.83	+0.19	−10.24
1690	+12.08	−0.83	−0.24	+11.01	1840	− 8.53	+0.80	+0.14	− 7.59
1700	+ 9.54	−0.82	−0.22	+ 8.50	1850	− 5.35	+0.73	+0.08	− 4.54
1710	+ 6.51	−0.76	−0.19	+ 5.56	1860	− 1.89	+0.63	+0.01	− 1.25
1720	+ 3.13	−0.67	−0.14	+ 2.32	1870	+ 1.67	+0.49	−0.05	+ 2.11
1730	− 0.41	−0.54	−0.08	− 1.03	1880	+ 5.14	+0.32	−0.11	+ 5.35
1740	− 3.94	−0.38	−0.01	− 4.33	1890	+ 8.34	+0.14	−0.17	+ 8.31
1750	− 7.26	−0.21	+0.05	− 7.42	1900	+11.10	−0.05	−0.21	+10.84
1760	−10.17	−0.01	+0.11	−10.07	1910	+13.28	−0.24	−0.24	+12.80

CHAPTER X.

DISCUSSION OF THE MOON'S MEAN MOTION IN LONGITUDE.

49. From the preceding reductions and corrections and from the material found in the Researches of 1878 it is now proposed to discuss the moon's mean motion in longitude from all observations, ancient and modern, and to determine the fluctuations in mean longitude which can not be explained by theory. The material on which this discussion is based is the following:

(*A*) The ancient eclipses of the moon used by Ptolemy in his Almagest to determine the elements of the moon's motion.

(*B*) The Arabian observations of eclipses collected by Ibn Junis.

(*C*) Occultations of stars between 1621 and 1750, including occultations and eclipses observed by Bullialdus, Gassendus, and Hevelius between 1620 and 1690, as discussed in the Researches of 1878.

(*D*) Modern occultations from 1750 to 1908, the results of which have already been tabulated.

Were there no unaccounted-for fluctuations in the mean longitude, all the corrections to that element could be represented in the form $a+bt+ct^2$. But this is found not to be the case, and the fluctuations of $\Delta\lambda$ require a special treatment of the equations.

Although the observations of importance before 1750 are published and discussed in the Researches of 1878, where they are compared with the longitudes of Hansen's tables, it seems desirable, in view of the importance of the subject, to revise the discussion on all points where additional light has been thrown by recent researches or by mature consideration.

The rediscussion of the first two of the preceding periods has been carried through quite independently in a very valuable paper by Mr. Nevill,[a] in which these observations are discussed with great thoroughness. Mr. Nevill's work was, in fact, unnoticed by me at the time of making the present rediscussion. But it will be of great interest to compare his results with those independently reached by myself, and this I have done in part.

The deviation of the revised results from the earlier ones is so small that no extended presentation of the revision seems necessary. The main points are the following:

The first eclipse of the series, −720, March 19, is quite discordant, as was pointed out by Mr. Nevill shortly after my paper was published. The statement as quoted by Ptolemy is that "the eclipse began when one hour had quite far passed after the rising" (of the moon). Ptolemy has assumed an hour and a half as the interval but it seemed to me more likely to be earlier than this. But on submitting the question of the admissible range of interpretation to Professor Carroll, of the George Washington University, the possible range of time seemed so wide that Ptolemy's estimate was accepted.

In the earlier work a somewhat problematic correction of the times was applied on account of the interval between the beginning of an eclipse and the time when it first became visible. But I have been led to drop this correction, because the darkness of the moon might be seen before the actual entrance of the limb into the shadow. In fact, a comparison of the results would lead to the conclusion that the beginning was recorded even earlier than the actual phase of totality.

Period A.—The system on which the author proceeded in his former discussion of these eclipses was to reach a conclusion as to the reliability and probable error of each phase described by Ptolemy without respect to discordances between observation and theory. Assuming only normal sources of error this proceeding is logically the best. It avoids the objectionable process of rejecting or retaining observations of equal value, according as they do or do not coincide with the results of other observations. At the same time it must be admitted that abnormalities are possible which would require an observation to be rejected.

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[a] Monthly Notices, R. A. S., Vol. LXVII, p. 2; 1906–7.

The most troublesome eclipse to deal with is the first quoted by Ptolemy, of which the year is −720. The time of beginning is discordant from the others by more than half an hour. In the discussion of the subject, which appeared shortly after the publication of the work, Mr. Nevill shows the discordance between the first four Babylonian eclipses and all the others in a strong light and reaches the conclusion that this group should have been thrown out entirely.

The writer does not conceive that the discordance is such that this proceeding would be justifiable. The furthest he has thought it admissible to go in the direction suggested by Nevill is to adopt Ptolemy's conclusion as to time of beginning of the first eclipse, making it one hour thirty minutes after moonrise, instead of one hour twenty-two minutes, which was first done. The results are as follows: First is shown the corrections to tabular times given by the observations and the respective weights in the old work; then the results which are now adopted in preference. The second eclipse of the group was in the early discussion rejected entirely owing to the uncertainty of the time, which was stated as the middle of the night. It is now retained with a small weight. Another change which we have made in the present discussion is to omit a somewhat conjectural correction to the times of beginning and ending on the ground that the eclipse would not be seen as beginning until some minutes after the moon had impinged upon the shadow of the earth. On further consideration it appears to me that as the darkening of the moon's limb would be very perceptible, even before the moment of entering into the shadow, and as we may presume the eclipses were expected, the more probable supposition now seems to be that the first contact with the actual shadow was observed. This course is greatly strengthened by the fact that a comparison between the recorded times of beginning and ending of the two eclipses, both phases of which are observed, show a longer duration of the total phase than that taken by the moon in passing through the shadow itself.

The whole series of Ptolemaic eclipses may be divided into four groups and the mean taken. The following is a comparison of the work of 1878 with the revised work of 1908. Δt is the correction to the tabular time as computed from Hansen's tables:

Date.	T.	Δt (1878).	Δt (1908).	Δt (Nevill).
	c	m	m	m
−720, Mar. 19	−25.2	+ 8; wt. 3	+18; wt. 2	+23; wt. 2
−719, Mar. 18	−25.2	+63; wt. 0	+63; wt. 0.5	+63; wt. 0.5
−719, Sept. 1	−25.2	+43; wt. 1	+43; wt. 1	+43; wt. 2
−620, Apr. 21	−24.2	+44; wt. 2	+44; wt. 2	+44; wt. 3

Thus modified, the mean correction to the tabular time given by the group is $+36^{m}$, and to the Hansenian mean longitude of the moon $-18'$. The mean of Nevill's results is 39^{m} and $-19'$.

I have also subjected the results from the other eclipses to some slight revision, making the mean results for groups and the corrections to the adopted theory as follows:

Epoch.	T.	Obs.—H.	Nev.	Th—H.	Obs.—Th.
	c	′	′	′	′ ′
−684	−24.8	−18.0	−19	−25.0	+7.0±4
−381	−21.8	−26.5	−26	−18.0	−8.5±3
−189	−19.9	−18.5	−17	−14.2	−4.3±4
+134	−16.7	−15.0	−15	− 8.8	−6.2±3

In the preceding I have taken no account of Hansen's erroneous Venus term, but have in what follows.

Period B.—In the former work the Arabian observations were worked up so carefully that I do not deem it necessary to revise the results. The means and their reduction to theory are the following:

Epoch.	T.	Obs. − H.	Th − H.	Obs. − Th.
	c	′	′	′ ′
850	−9.5	−3.8	−1.2	−2.6 ± 2.4
927	−8.7	−1.6	−0.1	−1.5 ± 1.7
986	−8.1	−4.5	−0.1	−4.4 ± 1.3

Nevill has revised these eclipses, making a few changes and additions based on a study of the Arabian originals. The use of his work would add to the weight of the results without, I think, materially changing the general mean.

Periods C and D.—The observations of the years 1620–1670 are fully worked up in Researches of 1878, pages 205–230, and the results collected in pages 231–248. Including both eclipses and occultations I have formed the following mean corrections to the moon's longitude from the observations of Bullialdus, Gassendus, and Hevelius, from the separate results of the Researches of 1878. The column Th − H contains the sum of the reductions in the table on page 30 and Δ Th in the preceding section.

Year.	Obs. − H.	Th − H.	Obs. − Th.
	″	″	″ ″
1621	+78	+54	+24 ± 14
1635	+54	+57	− 3 ± 7
1639	+27	+56	−29 ± 5
1645	+44	+56	−12 ± 6
1653	+34	+55	−21 ± 8
1662	+36	+52	−16 ± 4

For the years 1672–1908 I have adopted mean results from the smoothed-off means of §46. In forming these corrections for the purpose in question, their fluctuations are seen to be such that it is quite useless to aim at definitive values of the corrections. Approximate preliminary values are as good as the best until something is learned of the law or cause of the fluctuations.

50. *Observed mean corrections to the purely theoretical longitude of the moon through the period of 2,592 years, from −684 to 1908, with their probable errors:*

Year.	$\Delta\lambda$	p. e.	Year.	$\Delta\lambda$	p. e.
	″	″		″	″
− 684	+420	240	1737	+ 2.8	1
− 381	−510	180	1747	+ 6.0	1
− 189	−258	240	1757	+ 8.3	1
+ 134	−372	180	1780	+13.9	1
850	−156	144	1795	+13.3	1
927	− 90	102	1806	+12.4	1
986	−264	78	1820	+11.5	1
1621	+ 24	14	1830	+ 8.3	1
1635	− 3	7	1840	+ 7.6	1
1639	− 29	5	1850	+ 6.3	1
1645	− 12	6	1860	+ 6.2	1
1653	− 21	6	1870	− 0.3	1
1662	− 16	4	1880	− 4.1	1
1681	− 14	1	1890	− 8.5	1
1710	− 5.2	1	1900	− 7.6	1
1727	− 0.1	1	1908	− 6.3	1

51. *Preliminary solution of the equations of condition for the moon's mean motion.*—If the moon's mean motion could be represented by gravitational theory, its derivation from the preceding corrections given by observation would be extremely simple. It would require only the solution by least squares of equations of condition involving three unknown quantities, the mean longitude at any selected epoch, the mean motion at that epoch, and the secular acceleration. But, as I have already remarked, and as is evident from the run of the corrections, there are fluctuations in the motion which make it impossible to derive any definite result without taking them into account. The difficulty of the problem is increased by the fact that we can make no plausible assumption as to the permanent form of these fluctuations. So long as they might be supposed to arise from defects in the computations of gravitational theory we might plausibly suppose them to arise from actual periodic terms which had eluded our scrutiny. But to-day it seems almost as certain as any proposition in mathematical science can be that there are no known masses of matter, the gravitational action of which could produce the observed effects. Working quite independently of each other, I feel that Brown and I have examined every possible term and made such estimation of its limiting possible magnitude as to ensure the correctness of our conclusions. Brown has gone yet further by finding the limiting value of any possible omitted term to be insensible. In the Researches of 1878 I brought out the curious result that the great fluctuation could be represented by a very small change in the argument and coefficient of the Hansenian Venus term; in fact, that little more was necessary than to change the algebraic sign of the constant term in the argument. I did not notice at the time that the angle to be changed could be practically identified with the longitude of the node of Venus, in which no change is of course possible. The singular coincidence must therefore be regarded as accidental, in view of the fact already cited that several fundamentally different ways lead to the same result.

A similar remark applies to the term of nearly the same long period arising from the argument $13\,E-8\,V$, which gives rise to an important term in the mutual action of the Earth and Venus. It seems to be fully proven that there can be no corresponding term in the motion of the moon except the unimportant one first computed by Delaunay.

Additional weight is given to our negative conclusion by the fact that although the great fluctuation may be represented by a term of about 270 years, even the introduction of this term fails to completely represent the observations. There are still fluctuations outstanding which it is impossible to reconcile with gravitational theory, and, in fact, which do not admit of representation by a trigonometric series without introducing a number of terms, each purely empirical, and which we can have no reason for believing to be expressions of the actual law, if law there be.

One conclusion from these facts is that there is no value which we can assign to the moon's undisturbed mean motion as definitive. Representing the mean longitude in the form

$$\lambda=a+bt+st^2+\mathrm{F},$$

where F represents the sum of all the fluctuations, we have no assurance that any empirical formula we may construct for F will not in the future be found to require a correction of the same form as the sum of the three terms of λ above given. The coefficients of this correction will then have to be subtracted from the corresponding values of a, b, and s, so as to insure the best general representation of the observed facts. Thus, no such values can be definitive until we succeed in establishing the form of F in its completeness.

Another proceeding may also be adopted. Since we know nothing of the actual law of F, it may be claimed that we should make no hypothesis as to that law, but determine a, b, and s so as to make F as small as possible in a general way.

We shall solve the equations by both these methods, beginning with that first named. But it must be remarked that, even in this solution, we have to adopt the principle of the second method, except as to the great fluctuation of long period. The amplitude of this fluctuation, in fact, represents the largest part of the value of F, but by no means all of it.

What we have first to do is, therefore, to represent the excess of the observed over the theoretical mean longitude in the form

$$x + yT + zT^2 + c\sin(A + Bt),$$

where c, A and B are to be determined so as best to represent the observations.

To effect the solution we express the fluctuation in the form

$$c\sin(A + Bt) = u\sin Bt + v\cos Bt,$$

where

$$u = c\cos A,$$
$$v = c\sin A.$$

Since the unknown quantity B does not enter in a linear form, our easiest course is to find by trial what value of this quantity will lead to the best solution. I have actually assumed the following four values of B:

$$B = 1^\circ.2;\ 1^\circ.3;\ 1^\circ.4;\ 1^\circ.5.$$

In forming the equations the question of the weights to be assigned would be a difficult one were it possible to derive determinate values of them. But, from the nature of the case, this is not possible. The outstanding residuals are not in the nature of independent deviations, but are markedly systematic. From the commencement of fairly precise observations in 1672 until the present time the purely accidental errors of observation are markedly less than the outstanding fluctuations, which are systematic in their character. What I have done is to assume each decennial mean result during the period since 1680 to be affected by a probable error ±1″. This is doubtless smaller than the probable value of the outstanding residual; but its acceptance may be justified by the fact that the end at which we are practically aiming is that of predicting the moon's motion during the next 25 years, and that we can probably best do this by making our empirical theory fit as well as may be into modern observations.

Where the probable errors and the coefficients of the equation are both so large as in the case of the ancient observations the most convenient method of reducing the conditional equations is to divide each by its probable error, so that the weight shall be the same throughout.

From the uncertain character of the fluctuating term neither the ancient nor the mediæval observations can be of use in its determination. It is therefore only necessary to introduce the coefficients of the fluctuation into the modern observations.

Equations of Condition of Equal Weight for the Assumed Values of B.

				B=1°.20		B=1°.30		B=1°.40		B=1°.50		″	p. e.
−681	0.00x	−0.10y	+2.58z									=+ 1.8	240
−381	0.00	−0.12	+2.64									=− 2.8	180
−189	0.00	−0.08	+1.65									=− 1.1	240
+131	+0.01	−0.09	+1.54									=− 2.1	180
850	+0.01	−0.07	+0.63									=− 1.1	144
927	+0.01	−0.09	+0.76									=− 0.9	102
986	0.00	−0.10	+0.85									=− 3.4	78
1621	+0.07	−0.13	+0.23	+0.04u	−0.06v	+0.06u	−0.04v	+0.07u	−0.02v	+0.07u	+0.00v	=+ 1.7	14
1635	+0.14	−0.26	+0.39	+0.04	−0.14	+0.08	−0.12	+0.11	−0.09	+0.13	−0.05	=− 0.4	7
1639	+0.20	−0.32	+0.52	+0.05	−0.19	+0.10	−0.17	+0.14	−0.14	+0.18	−0.10	=− 5.8	5
1645	+0.17	−0.26	+0.40	+0.02	−0.16	+0.06	−0.15	+0.10	−0.13	+0.13	−0.10	=− 2.0	6
1653	+0.17	−0.25	+0.36	−0.01	−0.17	+0.04	−0.16	+0.07	−0.15	+0.11	−0.13	=− 3.5	6
1662	+0.25	−0.35	+0.48	−0.06	−0.24	0.00	−0.25	+0.06	−0.24	+0.11	−0.22	=− 4.0	4
1681	+1.00	−1.19	+1.42	−0.61	−0.80	−0.43	−0.90	−0.23	−0.97	−0.03	−1.00	=−14.0	1
1710	+1.00	−0.90	+0.81	−0.95	−0.31	−0.89	−0.45	−0.81	−0.59	−0.71	−0.71	=− 5.2	1

Equations of Condition of Equal Weight for the Assumed Values of B—Continued.

				B=1°.20		B=1°.30		B=1°.40		B=1°.50		″	*p. e.*
1727	+1.00x	−0.73y	+0.53z	−1.00u	+0.04v	−1.00u	−0.09v	−0.98u	−0.21v	−0.94u	−0.33v	=− 0.1	1
1737	+1.00	−0.63	+0.40	−0.97	+0.25	−0.99	+0.14	−1.00	+0.03	−1.00	−0.08	=+ 2.8	1
1747	+1.00	−0.53	+0.28	−0.89	+0.44	−0.93	+0.36	−0.96	+0.27	−0.98	+0.18	=+ 6.0	1
1757	+1.00	−0.43	+0.18	−0.78	+0.62	−0.83	+0.56	−0.87	+0.50	−0.90	+0.43	=+ 8.[illegible]	1
1780	+1.00	−0.20	+0.04	−0.41	+0.91	−0.44	+0.90	−0.47	+0.88	−0.50	+0.87	=+13.9	1
1795	+1.00	−0.05	0.00	−0.10	+1.00	−0.11	+0.99	−0.12	+0.99	−0.13	+0.99	=+13.3	1
1806	+1.00	+0.06	0.00	+0.13	+0.99	+0.14	+0.99	+0.15	+0.99	+0.16	+0.99	=+12.4	1
1820	+1.00	+0.20	+0.04	+0.41	+0.91	+0.44	+0.90	+0.47	+0.88	+0.50	+0.87	=+11.5	1
1830	+1.00	+0.30	+0.09	+0.59	+0.81	+0.63	+0.78	+0.67	+0.74	+0.71	+0.71	=+ 8.3	1
1840	+1.00	+0.40	+0.16	+0.74	+0.67	+0.79	+0.62	+0.83	+0.56	+0.87	+0.50	=+ 7.6	1
1850	+1.00	+0.50	+0.25	+0.87	+0.50	+0.91	+0.42	+0.94	+0.34	+0.97	+0.26	=+ 6.3	1
1860	+1.00	+0.60	+0.36	+0.95	+0.31	+0.98	+0.21	+1.00	+0.10	+1.00	0.00	=+ 6.2	1
1870	+1.00	+0.70	+0.49	+1.00	+0.10	+1.00	−0.02	+0.99	−0.14	+1.00	−0.26	=− 0.3	1
1880	+1.00	+0.80	+0.64	+1.00	−0.10	+0.97	−0.24	+0.93	−0.38	+0.87	−0.50	=− 4.1	1
1890	+1.00	+0.90	+0.81	+0.95	+0.31	+0.89	−0.45	+0.81	−0.59	+0.71	−0.71	=− 8.5	1
1900	+1.00	+1.00	+1.00	+0.87	+0.50	+0.77	−0.64	+0.64	−0.77	+0.50	−0.87	=− 7.6	1
1908	+1.00	+1.08	+1.17	+0.77	+0.64	+0.64	−0.77	+0.48	−0.88	+0.31	−0.95	=− 6.3	1

The following normal equations, corresponding to the assumed values of B, were then formed:

B=1°.20

					″
+19.19 x	+1.60 y	+ 9.13 z	+ 2.57 u	+4.71 v	=+ 47.4
+ 1.60	+9.17	− 0.75	+ 9.47	+0.28	=+ 4.8
+ 9.13	−0.75	+28.55	+ 1.50	−2.46	=− 56.6
+ 2.57	+9.47	+ 1.50	+11.79	+0.14	=− 3.7
+ 4.71	+0.28	− 2.46	+ 0.14	+7.43	=+100.7

B=1°.30

					″
+19.19 x	+1.60 y	+ 9.13 z	+ 2.59 u	+3.14 v	=+ 47.4
+ 1.60	+9.17	− 0.75	+ 8.91	+0.05	=+ 4.8
+ 9.13	−0.75	+28.55	+ 1.58	−3.44	=− 56.6
+ 2.59	+8.91	+ 1.58	+11.47	−0.13	=− 4.7
+ 3.14	+0.05	− 3.44	− 0.13	+7.68	=+102.6

B=1°.40

					″
+19.19 x	+1.60 y	+ 9.13 z	+ 2.57 u	+1.60 v	=+ 47.4
+ 1.60	+9.17	− 0.75	+ 8.20	−0.31	=+ 4.8
+ 9.13	−0.75	+28.55	+ 1.63	−4.35	=− 56.6
+ 2.57	+8.20	+ 1.63	+11.02	−0.35	=− 5.5
+ 1.60	−0.31	− 4.35	− 0.35	+8.14	=+104.0

B=1°.50

					″
+19.19 x	+1.60 y	+ 9.13 z	+ 2.51 u	+0.26 v	=+ 47.4
+ 1.60	+9.17	− 0.75	+ 7.42	−0.55	=+ 4.8
+ 9.13	−0.75	+28.55	+ 1.63	−5.09	=− 56.6
+ 2.51	+7.42	+ 1.63	+10.54	−0.41	=− 5.9
+ 0.26	−0.55	− 5.09	− 0.41	+8.71	=+104.2

The results obtained from a solution of these normal equations are exhibited in the following table:

Assumed Annual Motion of Argument.	1°.20	1°.30	1°.40	1°.50
Length of period in years	300	277	257	240
$x=$	− 0″.59	+ 0″.71	+ 1″.77	+ [illegible]″.67
$y=$	+ 2″.81	+ 2″.59	+ 2″.97	+ 2″.89
$z=$	− 0″.40	− 0″.47	− 0″.46	− 0″.53
$u=$	− 2″.55	− 2″.36	− 2″.66	− 2″.70
$v=$	+13″.70	+12″.80	+12″.20	+11″.63
$c=$	13″.94	13″.01	12″.49	11″.94
A=	100°.6	100°.5	102°.3	103°.1
Sum of squares of residuals	82″.6	77″.0	[illegible]	91″.6

We deduce from the above table Σpvv a minimum for B= 1°.31. The values of the elements corresponding are

x=Correction of λ for 1800	+ 0″.83
y=Correction of centennial motion	+ 2″.60
z=Correction of secular acceleration	− 0″.47
$u=c$ cos A	− 2″.37
$v=c$ sin A	+12″.73
$c=$	12″.95
A=	100°.6

The great fluctuation is therefore

$$\delta v = 12''.95 \sin \left\{ 1^\circ.31 \ (t - 1800.0) + 100^\circ.6 \right\}.$$

Period=275 years.

The definitive results for the moon's mean longitude may now be summed up as follows:

Fundamental Epoch, 1800, Jan. 0, G. M. N.
T, time from this epoch in Julian Centuries.

The expression for Hansen's mean longitude, measured from the moving mean equinox is

$$\lambda = 335^\circ\ 43'\ 26''.70 + (1336^{\text{rev.}} + 1108419''.61)T + 13''.301T^2 + 0''.01347T^3.$$

The reduction of this to the provisional systems N_1 and N_2 is

$$\Delta H = -1''.14 - 29''.17T - 3''.76T^2 - 0''.0067T^3.$$

We have just formed the further correction

$$\Delta N_2 = +0''.83 + 2''.60T - 0''.47T^2,$$

making the entire correction to Hansen

$$\Delta\lambda H = -0''.31 - 26''.57T - 4''.23T^2 - 0''.0067T^3,$$

and giving for the undisturbed value

$$\lambda = 335^\circ\ 43'\ 26''.39 + (1336^{\text{rev.}} + 1108393''.04)T + 9''.071T^2 + 0''.0068T^3.$$

Subtracting from the third term $1''.11T^2$ for precession, the observed sidereal secular acceleration becomes

$$7''.96T^2.$$

The following table shows the residual differences between the result of observations of the moon since 1620 and pure gravitational theory. In deriving the elements of mean motion it was necessary to divide the residual excess into two parts, one the great fluctuation just described, the other the smaller fluctuations which were superimposed upon it. In the table, the second column gives the minor fluctuations, which are in fact the residuals of the conditional equations. The ments

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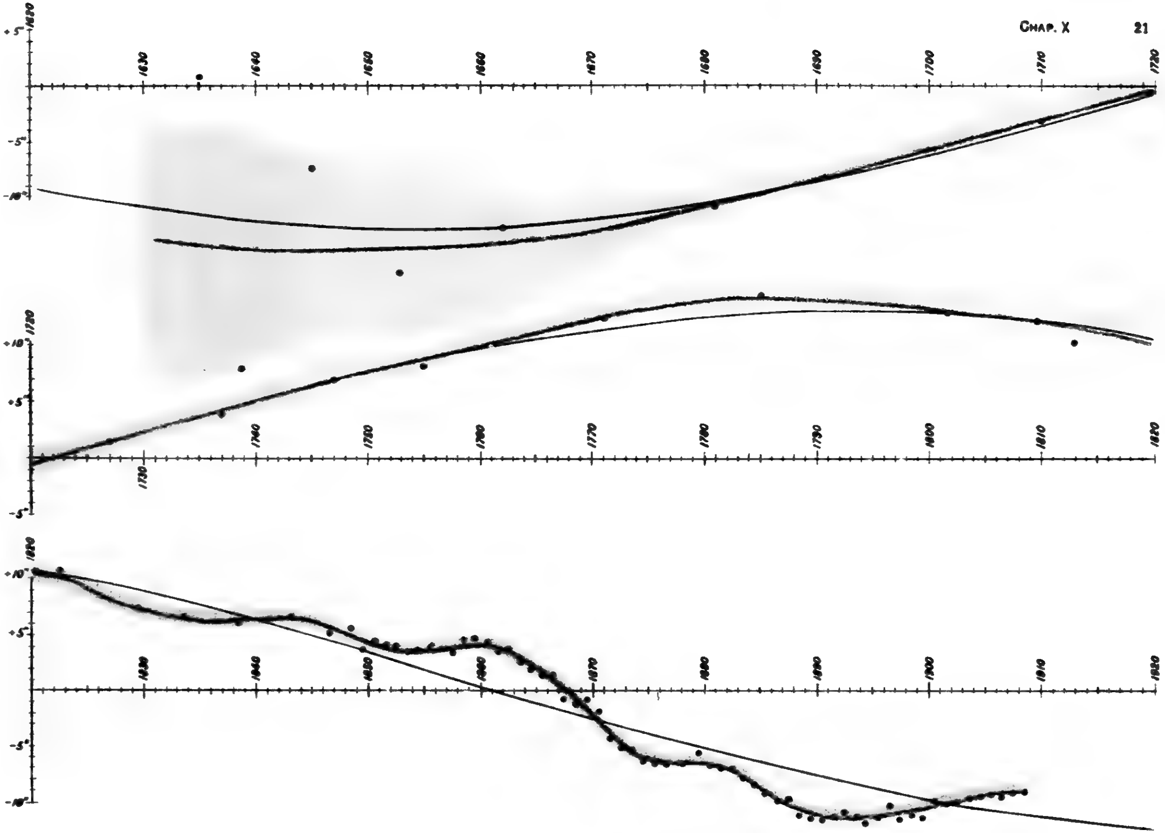

UNEXPLAINED FLUCTUATIONS IN THE MOON'S MEAN LONGITUDE: 1630-1908.

third column shows the main fluctuation as computed from the expression given above. The sum of the two found in the fourth column is the total excess of the moon's observed longitude over the result of gravitational theory. It is, however, to be remarked that in this theory is included the excess of the observed over the theoretical secular acceleration.

The unit of weight, as the latter is given in the last column, corresponds to a probable error of about ±0″.9, and a mean error of about ±1″.3. Being in many cases partly a matter of judgment, round numbers are preferred where it is doubtful. The limiting value assigned is 60, it being judged that the actual probable error can never be below ±0″.12.

Mean date.	Minor res.	Great fluctuation.	Total fluctuation.	Wt.	Mean date.	Minor res.	Great fluctuation.	Total fluctuation.	Wt.
	″	″	″			″	″	″	
1621.0	+39.0	− 9.6	+29.0	0.005	1866.5	+2.8	− 1.6	+ 1.2	6.0
1635.0	+13.0	−11.7	+ 1.0	0.02	1867.5	+1.1	− 1.9	− 0.8	5.0
1639.0	−13.0	−12.1	−25.0	0.04	1868.5	+1.0	− 2.2	− 1.2	10.0
1645.0	+ 5.0	−12.6	− 8.0	0.03	1869.5	+1.6	− 2.5	− 0.9	9.0
1653.0	− 4.0	−12.9	−17.0	0.03	1870.5	+0.7	− 2.8	− 2.1	6.0
1662.0	0.0	−12.7	−13.0	1.06	1871.5	−1.3	− 3.1	− 4.4	10.0
1681.0	− 0.4	−10.5	−10.9	2.0	1872.5	−1.8	− 3.3	− 5.1	16.0
1710.0	+ 0.5	− 3.7	− 3.2	6.0	1873.5	−1.8	− 3.6	− 5.4	12.0
1727.0	+ 0.1	+ 1.2	+ 1.3	3.0	1874.5	−2.2	− 3.9	− 6.1	8.0
1737.0	− 0.2	+ 4.1	+ 3.9	6.0	1875.5	−2.3	− 4.2	− 6.5	8.0
1747.0	0.0	+ 6.8	+ 6.8	5.0	1876.5	−2.1	− 4.4	− 6.5	30.0
1755.0	− 0.3	+ 8.7	+ 8.4	2.0	1878.0	−1.8	− 4.8	− 6.6	18.0
1771.0	+ 1.4	+11.2	+12.6	9.0	1879.5	−0.5	− 5.2	− 5.7	14.0
1784.7	+ 1.6	+12.7	+14.3	5.0	1880.5	−1.4	− 5.5	− 6.9	20.0
1792.0	+ 0.3	+12.9	+13.2	10.0	1881.5	−1.6	− 5.7	− 7.3	12.0
1801.5	− 0.6	+12.7	+12.1	12.0	1882.5	−1.4	− 6.0	− 7.4	8.0
1809.5	− 0.1	+11.9	+11.8	16.0	1883.5	−2.2	− 6.2	− 8.4	7.0
1813.0	− 1.2	+11.5	+10.3	16.0	1884.5	−2.1	− 6.5	− 8.6	30.0
1821.0	+ 0.1	+10.3	+10.4	14.0	1885.5	−2.5	− 6.7	− 9.2	50.0
1822.5	+ 0.6	+10.0	+10.6	10.0	1886.5	−2.8	− 7.0	− 9.8	18.0
1829.5	− 1.6	+ 8.6	+ 7.0	20.0	1887.5	−2.6	− 7.2	− 9.8	20.0
1833.5	− 1.6	+ 7.7	+ 6.1	10.0	1888.5	−3.5	− 7.5	−11.0	8.0
1838.5	− 0.6	+ 6.4	+ 5.8	30.0	1889.5	−3.5	− 7.7	−11.2	7.0
1843.0	+ 1.1	+ 5.2	+ 6.3	20.0	1890.5	−3.4	− 8.0	−11.4	10.0
1846.5	+ 1.1	+ 4.2	+ 5.3	10.0	1891.5	−3.1	− 8.2	−11.3	16.0
1848.5	+ 1.9	+ 3.7	+ 5.6	8.0	1892.5	−2.6	− 8.4	−11.0	17.0
1849.5	+ 0.1	+ 3.4	+ 3.5	15.0	1893.5	−2.7	− 8.6	−11.3	15.0
1850.5	+ 1.0	+ 3.2	+ 4.2	18.0	1894.5	−3.0	− 8.8	−11.8	30.0
1851.5	+ 0.8	+ 2.9	+ 3.7	12.0	1895.5	−2.2	− 9.0	−11.2	60.0
1852.5	+ 0.9	+ 2.6	+ 3.5	8.0	1896.5	−1.2	− 9.2	−10.4	60.0
1853.5	+ 0.7	+ 2.3	+ 3.0	7.0	1897.5	−2.0	− 9.5	−11.5	20.0
1854.5	+ 1.4	+ 2.0	+ 3.4	14.0	1898.5	−1.5	− 9.7	−11.2	28.0
1855.5	+ 2.1	+ 1.7	+ 3.8	6.0	1899.5	−1.4	− 9.9	−11.3	12.0
1856.5	+ 1.9	+ 1.4	+ 3.3	6.0	1900.5	0.0	−10.1	−10.1	15.0
1857.5	+ 2.1	+ 1.1	+ 3.2	9.0	1901.5	−0.1	−10.3	−10.4	16.0
1858.5	+ 3.5	+ 0.8	+ 4.3	8.0	1902.5	+0.3	−10.5	−10.2	18.0
1859.5	+ 3.9	+ 0.5	+ 4.4	6.0	1903.5	+0.6	−10.6	−10.0	12.0
1860.5	+ 3.9	+ 0.2	+ 4.1	12.0	1904.5	+1.1	−10.8	− 9.7	20.0
1861.5	+ 3.3	− 0.1	+ 3.2	5.0	1905.5	+1.5	−11.0	− 9.5	20.0
1862.5	+ 3.9	− 0.4	+ 3.5	7.0	1906.5	+1.3	−11.1	− 9.8	16.0
1863.5	+ 3.0	− 0.7	+ 2.3	6.0	1907.5	+2.0	−11.3	− 9.3	15.0
1864.5	+ 2.9	− 1.0	+ 1.9	10.0	1908.3	+2.1	−11.4	− 9.3	9.0
1865.5	+ 2.6	− 1.3	+ 1.3	5.0					

The accompanying plate gives a graphical representation in three sections of the residual deviations from pure theory, the motion derived from gravitational theory being represented by the straight medial lines. In order to show clearly the two parts into which the total fluctuation is divided, the term of great fluctuation is represented by a fine, sharp curve. The curve of actual longitude is bounded on each side by a shaded area showing the mean error at each point, which is nearly $^3/_2$ of the probable error. In this way not only the fluctuations as shown by observation are exhibited, but also the error to which the curve may be subject, the probability being ⅔ that at any point the true curve lies inside the shaded area, and ⅓ that it lies without it.

CHAPTER XI.

DISCUSSION OF THE REMAINING ELEMENTS WHICH CAN BE DETERMINED FROM THE OCCULTATIONS.

SECTION I.—PRELIMINARY SOLUTION.

52. As I have already several times remarked, observations of occultations are of special value in determining other astronomical elements than the moon's mean longitude, partly because of the early period when fairly good observations were begun and partly because of their comparative freedom from the systematic errors which affect meridian observations of the moon. It is now proposed to do for the equations of the period 1753–1908 what I have already done for the earlier occultations—solve the equations for the remaining unknown quantities.

The method which I shall adopt is, as for the older occultations, to regard the moon's mean longitude known with all the necessary precision from the preceding discussion so that it becomes a known quantity and then to substitute this in the first member of the equations and transpose the resulting term to the second term of the equation. The equations will then be solved for the remaining unknown quantities.

I do not disguise the fact that some question may be raised as to the rigor of this mode of proceeding, especially in the case of those unknown quantities which are correlated with the mean longitude. But I, notwithstanding, think that the results will be of interest and will probably be more accurate than those obtainable in any other way.

53. *Weights of the equations.*—In solving for the mean longitude we have made little distinction of weights except to reject abnormally discordant observations. But, in the present solution, it seems advisable to adopt a logically more rigorous method of procedure owing to the abnormal and systematic character of the statistical distribution of the residuals.

If this distribution followed the normal law the derivation of the results by the method of least squares would require only numerical computations by well-known methods, in which the judgment would be allowed no play. There would then be no room either for difference of opinion as to the treatment or for the exercise of judgment in reaching a result and assigning its probable error.

Discussion of the Equations.

But we scarcely enter upon the computation before we find the distribution of errors to be so different from that of the normal law that some modification of the method is necessary. The familiar method is to reject all observations, the residuals of which are so large as to indicate some abnormal sources of error, and to retain the others with unmodified weight. That this method is not the best one is very evident from the fact that it is necessary to assign some limit to the value of an error which can be regarded as normal, and that this limit is necessarily a matter of judgment. The final result then becomes a discontinuous function of the residual of the rejected observation, the continuity being broken at the point regarded as the limit of normal error. A simple example will make the case clear. If we have three observed results a, b, c, of which the mean is to be taken, and if c be the result which may be abnormal, then so long as c is retained we shall have

$$\text{Mean} = \frac{1}{3}(a+b+c);$$

the mean will then continually increase with c. When c passes the normal limit the mean changes per saltum to

$$\frac{1}{2}(a+b).$$

If c_0 be the limit, we have two values differing by the amount

$$\frac{1}{6}(2c_0-a-b),$$

of which we choose either one or the other. As the limit of abnormality is necessarily doubtful, being very largely a matter of judgment, it follows that if c is near the limit c_0, we shall be in doubt which of the two values are to be adopted. The laws of probability show that the best result is a weighted mean of the two, the weights being proportional to their probabilities. This involves making a weight to be assigned to an observation depend upon its deviation from the mean of the other observations, a proceeding which seems to violate the logical rules of procedure in combining observations. But the method is logically rigorous if properly applied.

The subject was treated by the writer in a former publication[a] where a method was shown of making the weight a function of the residual error of the observation. The fundamental idea of the method is quite simple. In the formula of distribution of the errors under the normal law it is assumed that the modulus of error (instead of which we may use the probable error) is a perfectly determinate quantity. Clearly this can never be the case in practice. The modulus of error must itself always be a more or less doubtful quantity. We can never say in practice that the chance is less than 1 out of 200 that a residual will be five times the assigned probable error. In a rigorous treatment of the subject what we should do is to regard the modulus itself as a doubtful quantity and to determine the law of the probability that it shall have any one of its separate possible values. It is shown in the paper referred to how a weight can be assigned the value of which shall diminish with the residual error of the observation to which it is applied.

The strict application of the method would require two approximations, too laborious to be remunerative except in the simple taking of means. Even then the advantage of applying it is not so much the attainment of increased precision as the satisfaction of the investigator in reaching an unbiased result. But in this case there is a modification which leads to a result practically as good as that of the rigorous method, and much easier. It consists in assigning a limit to the value which an entirely abnormal error may have; but if a residual exceeds that limit instead of throwing the observation out entirely, we assign it a weight diminishing with the magnitude of the residual.

In the paper already alluded to I have developed the theory of the diminution of weight. This of course depends upon the distribution of the possible values of the modulus of error. So long as this modulus is absolutely fixed the weights are equal. They vary with the range of possible values of the modulus.

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[a] American Journal of Mathematics, Vol. VIII, p. 343.

So little is gained by aiming at complete rigor of method that almost any modification which will prevent the incongruity of changing the weight per saltum from 1 to 0 at a certain point will do. Almost any reasonable law of diminution will answer the purpose. In taking a simple mean, an easy method which will lead to a result practically as good as the most rigorous treatment is this:

We premise that up to a certain limit e_0 the weight of an observation should not be diminished on account of its discordance. The question will arise as to the law of diminution of the weight when the residual error exceeds e_0. In this case let us put for Δ the excess of the error above the limit e_0. Then I propose to determine the weight by the condition

$$w=\frac{e_0}{e_0+\Delta}$$

This will lead to practically the same result as if we substituted for the actually observed quantity another quantity corresponding to the residual e_0. Instead of taking a mean by weights we change one of the quantities of which the mean is taken, and use the weight 1.

Of course there is still a certain amount of indetermination because the limit e_0 is a matter of judgment. But the influence of the judgment is far less than what results from continuing the usual fashion of treatment. Some observers throw out discordant observations much more freely than others, and they may still disagree as to the precise point where an observation is entitled to less weight; but their judgments will, in the latter case, differ much less than if the question were whether an observation should be rejected entirely or retained with full weight.

We shall still have to regard observations as quite abnormal, and reject them entirely, when the residuals are so large as to show some gross error. We then have an uncertainty which is in kind of the same general nature as that when the usual plan is adopted. But the doubt is reduced in two ways. In the first place the number of observations in which there can be any question of rejection or retention with diminished weight will be few. Moreover, the difference of the results, according to whether in these rare cases the observation is retained or rejected, will be small.

54. *Abbreviated method of solving the equations.*—Of the 8 unknown quantities which enter into the equations as written, 5 are to be regarded as increasing uniformly with the time. Thus in a rigorous treatment of the equations we should have to form normal equations in 13 unknown quantities, the labor of which would be great. I shall therefore adopt a method somewhat similar to that already applied in treating the equations of 1672–1747. Owing to the slowness of the change in most cases, it does not seem necessary to determine the most probable value in the way that we did in Chapter IX. What we shall do is first to determine the unknown quantities from the different groups of equations as they stand. We shall then develop the quantities thus determined in the form $a+bt$. In the earlier observations, especially those made before 1820, the number of observations in a group is so small that the probable error of the unknown quantity will be considerable. We must therefore proceed by adjustment and successive approximations, so as to reach as the final result what seems to be the most probable value of the unknown quantity with its secular variation.

In order to make the coefficients more homogeneous we have transformed several of the unknown quantities by multiplication by the factor 3; that is to say, we have taken, instead of the unknown quantity α_0 and δ_0, ⅓ of these unknowns.

Data for Normal Equations—Immersion.

	Unknown.	Group VI. 1753–1779.	Group VII. 1783–1801.	Group VIII. 1801–1820.	Group IX. 1821–1838.	Group X. 1839–1856.	Group XI. 1857–1873.	Group XII. 1874–1890.	Group XIII. 1891–1908.
Σaa	κ	+13.81	+14.18	+33.77	+80.88	+119.89	+109.41	+208.76	+371.00
ab	$i\theta$	+ 0.16	− 2.63	+ 0.86	+ 0.08	− 2.45	+ 1.14	− 3.57	+ 5.86
ac	i	− 1.12	+ 0.28	− 1.33	+ 3.59	− 8.58	+ 2.71	− 7.48	− 1.65
ad	b_0	+ 1.92	+ 3.81	+ 3.64	+ 2.26	− 4.21	+ 1.17	− 3.62	− 3.93
ae	$\frac{1}{3}\alpha_0$	+ 5.42	+ 4.33	+14.03	+31.20	+ 48.26	+ 33.97	+ 83.41	+136.24
af	$\frac{1}{3}\delta_0$	+ 0.44	+ 0.45	− 8.82	−25.10	− 14.30	− 25.74	− 11.31	+137.93
ag	ε	+ 2.59	+ 0.88	+ 2.11	+ 3.61	− 3.09	− 1.32	− 7.50	− 4.38
an	....	− 0.36	+16.77	+15.20	+29.43	+ 38.33	− 38.02	− 90.23	−131.55
bb	$i\theta$	+ 3.77	+10.83	+ 6.65	+21.10	+ 41.33	+ 49.97	+ 72.11	+132.19
bc	i	+ 0.57	− 0.41	+ 0.20	− 1.46	+ 3.05	+ 3.44	+ 0.09	+ 7.36
bd	b_0	− 0.76	− 3.44	+ 2.41	− 5.83	− 5.36	− 1.22	− 9.07	+ 11.99
be	$\frac{1}{3}\alpha_0$	+ 0.90	− 7.71	+ 1.20	− 5.89	− 3.93	− 9.36	− 9.20	− 32.41
bf	$\frac{1}{3}\delta_0$	− 1.41	− 2.11	+ 0.12	+ 3.60	− 3.28	+ 4.70	− 1.34	+ 0.15
bg	ε	+ 0.08	+ 0.42	− 0.30	+ 1.03	− 12.17	− 1.31	+ 2.43	+ 33.11
bn	....	+ 3.59	− 2.87	− 2.41	+ 2.60	+ 12.26	+ 1.54	+ 18.77	+103.38
cc	i	+ 4.95	+ 8.28	+ 7.69	+40.48	+ 50.74	+ 56.29	+109.12	+177.47
cd	b_0	+ 3.18	+ 3.28	− 3.57	− 2.92	− 2.04	+ 0.48	+ 1.29	+ 32.19
ce	$\frac{1}{3}\alpha_0$	+ 0.99	+ 2.37	− 2.07	+ 1.75	− 12.25	+ 3.04	+ 5.07	+ 3.43
cf	$\frac{1}{3}\delta_0$	− 0.87	− 1.30	+ 0.14	− 3.26	+ 3.67	+ 3.36	+ 1.45	+ 1.67
cg	ε	− 0.81	+ 1.78	− 3.19	− 4.14	− 4.05	− 5.62	− 21.29	+ 36.00
cn	....	− 0.93	+ 1.60	+ 0.83	− 0.91	− 13.60	− 17.78	− 35.28	− 8.76
dd	b_0	+ 8.82	+18.76	+14.27	+62.07	+ 92.04	+106.31	+181.51	+310.09
de	$\frac{1}{3}\alpha_0$	+ 1.69	+ 4.48	+ 5.48	+11.27	− 1.87	+ 20.56	+ 21.27	+ 23.91
df	$\frac{1}{3}\delta_0$	+ 1.27	− 4.35	+ 0.13	+ 5.15	+ 1.11	+ 6.02	+ 12.51	+ 3.20
dg	ε	+ 2.87	+ 5.09	+ 4.10	+21.57	+ 19.38	+ 18.60	+ 47.75	+112.87
dn	....	− 3.92	+ 5.27	+ 9.30	−19.76	− 41.17	− 63.15	− 80.71	−126.06
ee	$\frac{1}{3}\alpha_0$	+ 5.62	+22.97	+16.82	+56.08	+ 88.59	+106.70	+172.25	+294.42
ef	$\frac{1}{3}\delta_0$	− 2.12	+ 0.19	− 9.02	−17.31	− 9.42	− 8.38	− 28.07	+ 44.23
eg	ε	+ 1.87	+ 3.76	+ 3.20	+ 9.88	+ 4.30	+ 6.21	+ 6.31	− 14.14
en	....	− 3.04	− 6.28	+12.92	+ 8.82	+ 12.32	− 7.09	− 33.35	−114.77
ff	$\frac{1}{3}\delta_0$	+10.21	+24.29	+30.51	+76.12	+132.17	+106.35	+253.27	+467.03
fg	ε	+ 0.49	− 2.72	− 2.80	+ 0.35	+ 2.16	+ 0.74	+ 2.33	+ 3.51
fn	....	+ 0.80	+ 4.80	−10.96	− 2.66	− 24.19	+ 21.44	− 1.98	− 87.09
gg	ε	+ 6.38	+ 8.49	+ 8.70	+38.35	+ 55.66	+ 58.27	+110.77	+192.86
gn	....	− 2.95	+ 6.53	+ 9.24	+10.90	− 14.65	− 7.33	+ 22.90	+ 1.08

Marked correlation exists between several of the coefficients in these normal equations—notably between κ and α_0, and b_0 and ε. This will be considered a little later.

The above systems of equations were solved by the method of successive approximation. The resulting values of the unknowns are tabulated below:

Group.	κ	$i\theta$	i	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ε
	″	″	″	″	″	″	″
VI. 1753–1779	+0.41	+1.16	+0.02	−0.16	−0.93	+0.05	−0.29
VII. 1783–1801	+1.30	−0.66	+0.24	−0.20	−0.90	+0.22	+1.20
VIII. 1801–1820	+0.26	−0.62	+0.85	+0.53	+0.29	−0.12	+0.88
IX. 1821–1838	+0.40	−0.07	−0.04	−0.55	−0.02	+0.14	+0.56
X. 1839–1856	+0.30	+0.26	−0.27	−0.42	−0.08	−0.14	−0.04
XI. 1857–1873	−0.35	+0.07	−0.31	−0.64	+0.20	+0.19	+0.01
XII. 1874–1890	−0.49	+0.17	−0.29	−0.54	+0.12	+0.01	+0.34
XIII. 1891–1908	−0.29	+0.75	−0.03	−0.48	−0.12	−0.10	+0.13

Data for Normal Equations—Emersions.

	Group VI. 1753–1779.	Group VII. 1783–1801.	Group VIII. 1801–1820.	Group IX. 1821–1838.	Group X. 1839–1856.	Group XI. 1857–1873.	Group XII. 1874–1890.	Group XIII. 1891–1908.
Σaa	+6.59	+ 4.87	+10.16	+28.30	+50.27	+61.43	+110.03	+178.40
ab	−0.18	− 0.33	+ 1.42	− 1.32	+ 0.43	+ 1.31	− 4.65	− 4.16
ac	+0.83	+ 0.89	− 1.13	− 0.09	+ 0.81	− 0.54	+ 3.23	+ 6.76
ad	+1.74	+ 0.77	+ 1.89	+ 3.41	+ 2.11	− 1.42	− 3.39	− 3.66
ae	+2.12	+ 2.25	+ 5.48	+18.64	+16.49	+20.02	+ 45.61	+ 46.14
af	+2.34	+ 1.04	− 3.32	−18.80	− 1.54	−11.98	− 1.69	+ 59.38
ag	+0.75	+ 0.29	+ 0.11	+ 3.89	+ 1.63	+ 2.12	+ 8.17	− 2.27
an	+8.48	+ 6.87	− 1.77	+16.21	+ 6.91	− 4.98	− 47.92	− 83.58
bb	+1.34	+ 3.87	+ 3.09	+ 6.32	+11.83	+20.58	+ 29.79	+ 65.49
bc	+0.34	− 0.51	− 0.65	− 0.91	+ 0.60	− 0.10	− 2.96	− 0.34
bd	+0.82	+ 2.71	+ 2.09	− 0.40	+ 5.00	− 4.81	+ 1.89	+ 1.74
be	+0.59	− 2.05	+ 0.89	− 3.28	− 3.59	− 3.71	+ 1.87	− 26.89
bf	+0.84	− 0.15	+ 0.66	+ 0.87	+ 1.87	− 1.01	+ 0.15	+ 2.13
bg	+0.42	+ 1.50	− 0.55	− 0.01	− 4.18	− 1.04	− 0.44	+ 14.27
bn	−2.86	− 0.89	− 0.41	− 4.75	+ 6.71	+ 5.55	+ 18.22	+ 53.00
cc	+1.23	+ 1.18	+ 3.89	+15.22	+22.32	+21.09	+ 57.39	+ 89.83
cd	+1.20	− 0.93	− 2.39	+ 1.70	− 4.24	− 2.77	− 7.06	+ 16.79
ce	+0.72	+ 1.05	− 1.37	+ 1.78	− 4.85	− 1.92	+ 11.57	+ 20.57
cf	+0.23	+ 0.35	+ 0.32	− 1.91	− 2.41	+ 0.77	− 4.76	+ 3.69
cg	+0.19	− 1.13	− 2.57	+ 0.32	− 2.25	+ 0.28	− 9.35	+ 21.87
cn	−1.24	+ 1.52	− 4.72	+ 9.36	− 9.76	− 5.03	− 30.94	− 12.41
dd	+2.60	+ 5.08	+ 7.09	+21.58	+34.27	+41.63	+ 87.82	+154.63
de	+1.26	− 2.22	+ 4.08	+ 6.95	+ 4.72	+ 1.06	+ 12.90	+ 22.91
df	+0.59	+ 0.41	− 2.92	− 2.47	+ 4.16	+ 5.47	− 8.17	+ 22.73
dg	+1.75	+ 3.36	+ 1.90	+11.71	+ 5.84	+ 9.42	+ 24.99	+ 45.85
dn	+0.07	+ 0.31	+ 1.91	+ 3.93	+ 0.44	+ 0.24	− 29.77	− 40.79
ee	+2.68	+ 4.38	+ 9.97	+29.55	+32.28	+35.78	+ 72.77	+144.68
ef	+1.20	+ 2.83	− 5.69	−14.30	+ 0.94	− 6.52	− 12.96	+ 8.37
eg	+1.02	− 0.52	+ 1.55	+ 5.78	+ 9.56	+ 7.37	+ 17.41	+ 13.21
en	−2.50	+ 5.57	− 5.72	+ 3.84	− 5.56	+ 0.32	− 37.47	− 39.42
ff	+3.86	+12.29	+11.90	+20.49	+52.13	+62.17	+ 97.17	+253.23
fg	+0.13	+ 0.30	+ 0.33	− 2.13	− 0.74	− 0.88	− 2.08	+ 3.97
fn	−3.41	+ 7.87	+ 4.74	− 7.24	+ 7.64	+ 3.49	+ 7.65	− 70.84
gg	+1.65	+ 4.14	+ 3.96	+12.78	+22.39	+26.96	+ 62.70	+ 92.63
gn	−1.43	− 0.47	+ 3.13	− 5.45	−19.43	+ 4.42	− 57.09	− 15.66

On account of their small weight, it is not worth while to solve Groups VI–VIII above. The results of the solution of Groups IX to XIII are exhibited below:

Group.	κ	$i\theta$	i	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ϵ
	″	″	″	″	″	″	″
IX. 1821–1838	+1.35	−0.66	+0.63	+0.86	−0.51	+0.58	−1.34
X. 1839–1856	+0.21	+0.23	−0.55	+0.06	−0.10	+0.11	−0.86
XI 1857–1873	−0.10	+0.30	−0.24	−0.02	+0.06	+0.06	+0.17
XII. 1874–1890	−0.38	+0.48	−0.69	−0.19	+0.09	+0.01	−0.91
XIII. 1891–1908	−0.42	+0.88	−0.04	−0.21	+0.11	−0.17	−0.21

Data for Normal Equations, Immersions and Emersions combined.

	Groups I–V. 1672–1746.	Group VI. 1753–1779.	Group VII. 1783–1801.	Group VIII. 1801–1820.	Group IX. 1821–1838.	Group X. 1839–1856.	Group XI. 1857–1873.	Group XII. 1874–1890.	Group XIII. 1891–1908.
Σaa	+40.86	+20.40	+19.05	+43.93	+109.18	+170.16	+170.84	+318.79	+549.40
ab	+1.15	−0.02	−2.30	+2.28	−1.24	−2.02	+2.45	−8.22	+1.70
ac	.....	−0.29	+1.17	−2.46	+3.50	−7.77	+2.17	−4.25	−5.11
ad	+0.10	+3.66	+4.58	+5.53	+5.67	−2.10	−0.25	−7.01	−7.59
ae	+12.61	+7.54	+6.58	+19.51	+49.84	+64.75	+53.99	+129.02	+182.38
af	+4.86	+2.78	+1.49	−12.14	−43.90	−15.84	−37.72	−13.00	+197.31
ag	−0.21	+3.34	+1.17	−2.22	−7.50	+1.46	+0.80	+0.67	−6.65
an	+23.96	+8.12	+23.64	−2.82	+45.64	+45.24	−43.00	−138.15	−215.13
bb	+14.62	+5.11	+14.70	+9.74	+27.42	+53.16	+70.5[illegible]	+101.90	+197.68
bc	.....	+0.91	−0.92	−0.45	−2.37	+3.65	+3.34	−2.87	+7.02
bd	−4.37	+0.06	−0.73	+4.50	−6.23	−0.36	−6.03	−7.18	+13.73
be	−1.55	+1.49	−9.76	+2.09	−9.17	−7.42	−13.07	−7.33	−59.30
bf	−1.71	−0.57	−2.26	+0.78	+4.47	−1.41	+3.69	−1.19	+2.28
bg	−6.34	+0.50	+1.92	−0.85	+1.02	−16.35	−2.35	+1.99	+47.38
bn	−18.91	+0.73	−3.76	−2.82	−2.15	+18.97	+7.09	+36.99	+156.38
cc	.....	+6.18	+9.46	+11.58	+55.70	+73.06	+77.38	+166.51	+267.30
cd	.....	+4.38	+2.35	−5.96	−1.22	−6.28	−2.29	−5.77	+48.98
ce	.....	+1.71	+3.42	−3.44	+3.53	−17.10	+1.12	+16.64	+24.00
cf	.....	−0.64	−0.95	+0.46	−5.17	+1.26	+4.13	−3.31	+5.36
cg	.....	−0.62	+0.65	−5.76	−3.82	−6.30	−5.34	−30.64	+57.87
cn	.....	−2.17	+3.12	−3.89	+8.45	−23.36	−22.81	−66.32	−21.17
dd	+38.46	+11.42	+23.84	+21.36	+83.65	+126.31	+147.94	+269.33	+464.72
de	+4.90	+2.95	+2.26	+9.56	+18.22	+2.85	+21.62	+34.17	+46.82
df	+6.10	+1.86	−3.94	−2.79	+2.68	+5.27	+11.49	+4.34	+25.93
dg	+23.93	+4.62	+8.45	+6.00	+33.28	+25.22	+28.02	+72.74	+158.72
dn	+37.02	−3.85	+5.58	+11.21	−15.83	−40.73	−62.89	−110.48	−166.85
ee	+23.88	+8.30	+27.35	+26.79	+85.63	+120.87	+142.48	+245.02	+439.10
ef	−2.93	−0.92	+3.02	−14.71	−31.61	−8.48	−14.90	−41.03	+52.60
eg	+7.45	+2.89	+3.24	+4.75	+15.66	+13.86	+13.58	+23.72	−0.93
en	+23.59	−5.54	−0.71	+7.20	+12.66	−6.76	−6.77	−70.82	−154.19
ff	+32.34	+14.07	+36.58	+42.41	+96.61	+184.30	+168.52	+350.44	+720.26
fg	+3.11	+0.62	−2.42	−2.47	−1.78	+1.42	−0.14	+0.25	+7.48
fn	+7.68	−2.61	+12.67	−6.72	−9.90	−16.55	+24.93	+5.67	−157.93
gg	+25.58	+8.03	+12.63	+12.66	+51.13	+78.05	+85.23	+173.47	+285.49
gn	+23.75	−4.38	+6.06	+12.37	+5.45	−34.08	−2.91	−34.19	−16.74

Method of Solving for the Unknown Corrections.

The following values have been adopted as a first approximation to the unknown quantities. They have been obtained by combining the values just given separately for the immersions and emersions. The weights assigned below have not been chosen on any uniform plan, the probable error for weight unity varying with the unknown to which it is attached.

Group.	Mean date.	T−1850.	κ	Wt.	$i\theta$	Wt.	i	Wt.	b_0	Wt.	$\frac{1}{3}\alpha_0$	Wt.	$\frac{1}{3}\delta_0$	Wt	ε	Wt.
			″		″		″		″		″		″		″	
I–V	1720	−1.30	+0.44	25	−1.03	9	....	...	....	...	+0.54	16	+0.12	25	+0.50	16
VI	1761	−0.89	+0.41	9	+1.16	4	+0.02	3	−0.16	5	−0.95	4	+0.05	9	−0.29	4
VII	1792	−0.58	+1.30	16	−0.66	9	+0.24	7	−0.20	15	−0.90	25	+0.22	25	+1.20	9
VIII	1811	−0.39	+0.26	25	−0.62	9	+0.85	6	+0.53	10	+0.29	16	−0.12	25	+0.88	9
IX	1829	−0.21	+0.67	100	−0.18	25	+0.13	54	−0.16	70	−0.18	64	+0.23	100	+0.09	49
X	1848	−0.02	+0.27	100	+0.25	49	−0.35	68	−0.30	120	−0.09	100	−0.08	100	−0.28	64
XI	1865	+0.15	−0.26	100	+0.14	81	−0.29	75	−0.55	130	+0.17	100	+0.14	100	+0.06	81
XII	1882	+0.32	−0.45	100	+0.25	100	−0.42	160	−0.42	240	+0.11	100	+0.01	100	−0.14	100
XIII	1899	+0.49	−0.34	100	+0.79	100	−0.03	250	−0.38	400	−0.04	100	−0.13	100	0.00	100

From these values we have derived by a least square solution the correction to the adopted values of the elements for the epoch 1850, as well as the correction to the adopted centennial motions. The results of this solution follow:

$$\left.\begin{array}{r@{}l} \kappa= & +0.07''-0.85'' (T-1850) \\ i\theta= & +0.17+0.75 (T-1850) \\ i= & -0.17 \\ b_0= & -0.37 \\ \tfrac{1}{3}\alpha_0= & -0.03+0.13 (T-1850) \\ \tfrac{1}{3}\delta_0= & +0.04-0.15 (T-1850) \\ \varepsilon= & +0.05-0.33 (T-1850) \end{array}\right\} (a)$$

It has been assumed that i and b_0 are constants. These values of the elements have been used as a first approximation in obtaining more correct values, in the following way: Take for instance the unknown sin $i\,\delta\Omega$. The normal equation in sin $i\,\delta\Omega$, which is the second equation in each group, is used as a basis of obtaining a second approximation to its value. It is first thrown into the form

$$y=\frac{[bn]}{[bb]}-\frac{[ab]}{[bb]}x-\frac{[ac]}{[bb]}z-\frac{[ad]}{[bb]}s \quad . \quad . \quad . \quad .$$

in which $y=\sin i\,\delta\Omega$. There are nine such equations in y, one corresponding to each group. As the coefficients $\frac{[ab]}{[bb]}, \frac{[ac]}{[bb]}$ . . . . are small fractions, we need only approximate values of $x, z, s,$ . . . , in order to get a more accurate value of y. These values of $x, z, s,$ . . . for this substitution are obtained from equations (a). In this manner all the unknowns have been solved anew with the following results:

Group.	κ	$i\theta$	i	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ε
	"	"	"	"	"	"	"
I-V	+0.64	−1.27	. . .	+0.56	+0.30	+0.03	+1.12
VI	+0.45	+0.20	+0.11	−0.66	−1.23	−0.35	−0.61
VII	+1.33	−0.28	+0.35	+0.08	−0.26	+0.29	+0.79
VIII	+0.42	−0.20	−0.38	+0.40	+0.12	−0.08	+1.03
IX	+0.50	−0.21	+0.14	−0.25	+0.11	−0.01	+0.33
X	+0.26	+0.39	−0.35	−0.34	−0.01	−0.07	−0.29
XI	−0.25	+0.08	−0.31	−0.42	+0.06	+0.15	+0.09
XII	−0.43	+0.32	−0.42	−0.39	−0.10	+0.01	−0.07
XIII	−0.39	+0.86	−0.02	−0.33	−0.09	−0.11	+0.08

From these values the following second approximation to the elements were obtained in the same manner as before:

$$\left.\begin{array}{r@{}l} \kappa= & +0.06''-0.92''(T-1850) \\ i\theta= & +0.16+1.02(T-1850) \\ i= & -0.18 \\ b_0= & -0.31 \\ \tfrac{1}{3}\alpha_0= & -0.02-0.08(T-1850) \\ \tfrac{1}{3}\delta_0= & 0.00-0.04(T-1850) \\ \varepsilon= & +0.14-0.50(T-1850) \end{array}\right\} (b)$$

Starting anew with the values (*b*), the solution was repeated in the same manner, with the following results:

Group.	Epoch.	κ	$i\theta$	i	b_0	$\frac{1}{3}\alpha_0$	$\frac{1}{3}\delta_0$	ε
		$''$	$''$	$''$	$''$	$''$	$''$	$''$
I–V	1720	+0. 58	−1. 11	. . .	+0. 32	+0. 05	0. 00	+0. 91
VI	1761	+0. 34	+0. 10	+0. 06	−0. 78	−1. 35	−0. 38	−0. 71
VII	1792	+1. 24	−0. 23	+0. 25	−0. 02	−0. 34	+0. 29	+0. 71
VIII	1811	+0. 34	−0. 23	−0. 25	+0. 29	+0. 02	−0. 04	+0. 95
IX	1829	+0. 43	−0. 17	+0. 15	−0. 25	+0. 04	+0. 01	+0. 26
X	1848	+0. 26	+0. 42	−0. 34	−0. 36	−0. 01	−0. 07	−0. 32
XI	1865	−0. 24	+0. 08	−0. 31	−0. 43	+0. 05	+0. 14	+0. 07
XII	1882	−0. 41	+0. 32	−0 41	−0. 39	−0. 10	0. 00	−0. 08
XIII	1899	−0. 36	+0. 83	−0. 03	−0. 32	−0. 06	−0. 10	+0. 04

These values lead to the following results for the correction to the elements for 1850 and their centennial motions with their probable errors:

$$\left.\begin{aligned}
&\qquad\quad {}'' \qquad\quad {}'' \\
x &= +\ 0.04 \pm 0.06 \\
&\qquad -(0.83 \pm 0.15)(T-1850) \\
i\theta &= +\ 0.16 \pm 0.06 \\
&\qquad +(0.97 \pm 0.15)(T-1850) \\
i &= -\ 0.18 \pm 0.19 \\
b_0 &= -\ 0.32 \pm 0.14 \\
\tfrac{1}{3}\alpha_0 &= -\ 0.05 \pm 0.04 \\
&\qquad +(0.07 \pm 0.10)(T-1850) \\
\tfrac{1}{3}\delta_0 &= \quad\ 0.00 \pm 0.03 \\
&\qquad -(0.04 \pm 0.07)(T-1850) \\
\varepsilon &= +\ 0.09 \pm 0.07 \\
&\qquad -(0.40 \pm 0.16)(T-1850)
\end{aligned}\right\} (c)$$

Correlation between the Unknowns.

Correlation between x and α_0. The coefficient of α_0 is given by

$$\begin{aligned}
\alpha_0 &= F \sin m' - \cos\delta \sin m_1 \\
&= \sin m' - \cos\delta \sin m_1 + 2\, e \cos g \sin m'.
\end{aligned}$$

The coefficient of x is $\cos g \sin m'$, a quantity which, according to the above equation, is seen to enter into α_0, forming in fact a large percentage of its numerical value.

Correlation between b_0 and ε. We have

$$\begin{aligned}
\text{coeff. of } b_0 &= \cos m', \\
\text{“} \quad \text{“} \quad \varepsilon &= \cos m \sin L - \sin m \sin B \cos L.
\end{aligned}$$

The second term of ε is small. But on account of the large number of occultations of the Pleiades which we have used in the above discussion, for which $\sin L$ is nearly unity, the value of the coefficient of ε has a preponderance toward the value $\cos m$. As this differs but little from the coefficient of b_0, correlation will exist between the quantities b_0 and ε, if determined as above. In order to separate the two, only those equations of condition should be used which belong to stars which are well distributed in longitude.

SECTION II.—FINAL SHAPING OF THE RESULTS.

55. As the methods we have followed in working out results differ in several important points from those ordinarily used it is necessary for the sake of clearness to outline the relation of the various processes. In determining the elements of motion in the solar system, especially the coordinates of the sun, moon, and planets, the conclusive method consists in adopting positions of the fixed stars which are derived from observation and, assuming these positions to be correct, to determine the right ascensions and declinations of the sun, moon, and planets. Sometimes the declinations of these bodies are determined as absolute without reference to the declinations of the stars and in other forms of reduction they depend upon the latter.

In the case of occultation of stars by the moon all the determinations are, of course, relative; the positions of the moon are therefore referred to positions of the stars, assumed to need no correction. In this way we work out a system of corrections to the moon's coordinates, or of individual positions of the moon's center relative to the occulted stars. Assuming the latter to be known, we thus derive a large mass of relative corrections by which the corrections to the lunar elements are determined.

These elements necessarily have to be revised as improved positions of the stars are determined. But the great point which we have to recall is that by conclusive methods the work of determining the final positions of the stars is quite independent of that of determining the positions of the moon. Following this method, our course would be to adopt the best set of star positions, probably those of Professor Boss, and, assuming them to be absolute, to determine values of the lunar elements which would be regarded as definitive. Substantially this is what we have done, only instead of Boss's fundamental positions we have used those worked out in my own fundamental catalogue of 1900. The difference is probably not of prime importance, and in any case, it need not be considered, because the new course we are now taking seeks to derive independent systematic corrections to the star places of the occultations themselves. The relations between these various corrections are first expressed in the form of equations of condition, the solution of which on various hypotheses may be supposed to lead eventually to the best double result.

We thus have been dealing with two sets of corrections to the moon's elements, in one of which the positions of the stars are regarded as given, while in the other set the star positions are corrected from the occultations themselves.

What has been said of positions of the stars applies equally to those of the sun. Heretofore whenever eclipses have been used it has been exclusively to determine positions of the moon, those of the sun being assumed as given by the solar tables. But when we inquire how the data of observation can best be used we find that the process should be reversed and that the positions of the sun, or rather its mean longitude, and possibly the other solar elements should be determined from the occultations.

The idea on which we have proceeded has been to determine the systematic corrections of the star positions from the occultations themselves. We should expect the absolute right ascensions of the stars in the general mean, as well as the position of the equator among the stars, to admit of better determination from the occultations than from the meridian observations, especially when the means of the corrections are considered, each correction being of the form:

$$a+bt.$$

The earlier meridian observations are quite uncertain and this uncertainty must affect greatly the values of b. Now, fairly good observations of occultations extend back to 1700, while good mean observations of star positions are few in number before the work at Greenwich and Poulkova in 1840–1850. In other words, we have a range of more than two centuries in the results from occultations as against less than three-quarters of a century for the meridian observations themselves. This being remarked, is in addition to the known systematic errors which affect even the best meridian observations of declination.

56. *Corrections of the lunar elements relative to the stars.*—Let us inquire what corrections to the lunar elements we should derive if the places of the stars were exact; also assuming these places to require corrections, what discordances we should expect to find by ignoring the errors of the star places. Assuming the star positions to be exact, the elements which we determine from the occultations are:

λ, the correction to the moon's mean longitude;
κ, or $-2e\delta\pi$, the correction growing out of the lunar perigee;
i, the correction of the inclination;
$i\theta$, the correction of the node into the sine of the inclination.

We should also look for a common correction b_0 to all the latitudes of the moon. The values of λ then derived would be the same which we have already developed in the preceding chapter. The results for the other unknown quantities are obtained by several successive approximations to the unknown quantities, with the following results for the various groups.

Year.	Group.	κ	$i\theta$	i	b_0
		″	″	″	″
1720	I–V	+0.59	−1.48	. . .	+(0.83)
1766	VI	+0.40	+0.17	−0.09	− 0.53
1792	VII	+1.28	−0.20	+0.29	+ 0.11
1811	VIII	+0.35	−0.26	−0.42	+ 0.41
1830	IX	+0.45	−0.16	+0.14	− 0.21
1848	X	+0.25	+0.37	−0.35	− 0.33
1865	XI	−0.25	+0.09	−0.31	− 0.42
1882	XII	−0.43	+0.32	−0.41	− 0.41
1900	XIII	−0.39	−0.82	−0.05	− 0.37

By successive approximations we find that the unknown quantities developed in the form $a+bt$ are as follows. We count the time from 1850 as the most convenient fundamental epoch for our purpose.

$$
\begin{aligned}
-2e\delta\pi &= +0''.04 - 0''.86\,(T-1850)\\
\sin i\delta\Omega &= +0.13 + 1.06\,(T-1850)\\
\delta i &= -0.19\\
b_0 &= -0.36
\end{aligned}
$$

The interpretation of the first three unknowns involves no difficulty. It is different in the case of the latitude correction, which may arise from several sources, and which will require a separate investigation to be placed on a satisfactory basis.

We recall that Hansen applied a common correction of $-1''.00$ to all the moon's latitudes, accounting for it on the ground that there might be a displacement of the center of gravity of the moon from its center of figure. We must regard the introduction of this quantity as one of the unfortunate features of Hansen's tables, especially as there are other causes than that introduced by Hansen for such a discrepancy. These are:

1. An error in the adopted constant of the lunar parallax. This would result in a common systematic correction to all the declinations, and therefore to all the latitudes of the moon observed on the meridian in the northern hemisphere. Of course the result would be reversed in the southern hemisphere, but Hansen did not make use of any observations in that hemisphere. I do not think that the theoretical value of the lunar parallax which we have derived from the terrestrial value of gravity is likely to be in error by more than $0''.1$. This may be regarded as the possible error of our correction to Hansen's parallax, which we have found to be $0''.40$ (§26).

2. The other cause of the constant latitude discrepancy would be found in the common error of the declinations or latitudes of all the occulted stars.

3. It may well be that the lunar inequalities in the outline of the moon's disk are more or less systematic in their character, thus producing an apparent systematic error in b_0. Really this is practically identical with Hansen's hypothesis of a displacement of the centers of gravity and figures, since the apparent center of figure is altered by the lunar inequalities.

In forming the equations of condition I have assumed a value of this third displacement in a direction at right angles to the moon's varying orbit. I think this is not what we should expect from the theory of libration, but am unable to correct the result at present. The best that we can do, therefore, seems to be to ignore this correction, or rather to merge it with the common corrections to the latitudes of all the stars.

It may be added in this connection that the general method we have adopted will completely suffice to determine both the systematic amount of the Hansen inequality and the common correction to the declinations of all the stars. In fact, the formulæ which we have derived in Chapter II for the coefficients of the equations of condition enable an independent determination of the quantities to be made. But there still seems to be some discrepancy which the author is, in completing the work, unable to explain.

Our next important result will be the common correction to the Right Ascensions and Declinations of all the stars. From the equations (c), page 219, this comes out

$$\begin{aligned}\alpha_0 &= -0''.15+0''.21\,(T-1850),\\ \delta_0 &= 0.00-0.12\,(T-1850).\end{aligned}$$

I regard this correction to the equinox as probably more reliable than any heretofore obtained, so far at least as the centennial motion is concerned. As has already been explained it rests on the principle that the equinox can be determined from the moon as well as from the sun, while the probable error of the determination is much less. In the case of the equinoxes determined from the sun we have the unavoidable difficulties arising from the effect of the diurnal change of temperature on the instrument and the surroundings, and the uncertainty as to the personal equation of the observer. The latter is worthy of special consideration. Before the existence of the magnitude equation was known, it was necessarily assumed that there would be no personal equation between the observations of the sun and of a star. Now, if we suppose, as we might well do, that the personal equation is the same for the sun's limb and for a star of the first magnitude there would then be an equation of $0^s.05$ between the sun and a star of the seventh magnitude. We have assumed that the standard personal equation for magnitude corresponds to the magnitude 4.0, and this is the standard to which the preceding result alludes.

Our result, as derived from equations (c), may therefore be expressed in the following form: When the Right Ascensions are all reduced for magnitude equation to the standard magnitude 4.0 the correction for equinox is

$$\begin{aligned}\alpha_0 = &-0''.15\pm0''.12\\ &+(0.21\pm0.30)(T-1850).\end{aligned}$$

Expressed in time the results are:

$$\begin{aligned}\alpha_0 = &-0^s.010\pm0^s.008\\ &+(0.014\pm0.020)\,(T-1850).\end{aligned}$$

The apparent correction to the standard declination is yet smaller, which is surprising, because the general trend of evidence is that the standard adopted requires an appreciable correction. On this subject compare the catalogues of Boss and Auwers. On the other hand, we have to remember that the uncertainty arising from the figure of the moon can not be completely eliminated by the process we have followed and must, therefore, still affect this result.

SEC. III.—DEFINITIVE VALUES OF THE LUNAR ELEMENTS AS DERIVED FROM THIS INVESTIGATION.

For convenience of reference, the conclusions of the present paper as to the principal elements of the moon's motion will now be collected.

As different fundamental epochs are more convenient for different purposes we have chosen three, the comparison of which will serve as a check upon the values of the printed numbers. These epochs are:

1800, Jan. 0.0, G.M.N.; Julian date 2 378 497;
1850, Jan. 0.0, G.M.N.; Julian date 2 396 759;
1900, Jan. 0.0, G.M.N.; Julian date 2 415 021.

The time from these several epochs is counted in Julian centuries of 36525 days each.

T_0 means the time from 1800.0;
T_1 means the time from 1850.0;
T_2 means the time from 1900.0.

The epoch for $T=0$ is therefore indicated without ambiguity, depending on whether we use T_0, T_1, or T_2. I have always found this condensed method of expressing the time through long periods much more convenient than the ordinary method of using a fraction, dividing the years by 100 for centuries.

We have two sets of corrections designated as A and B. In the set A we have assumed the star places to be subject to corrections as shown below. In B the initial values are accepted without correction.

$$\left.\begin{array}{lrr}
 & '' & '' \\
\delta\pi = & -\ 0.36 & +\ \ 7.55\ T_1 \\
\delta\text{☊} = & +\ 1.79 & +\ 10.84\ T_1 \\
\delta i = & -\ 0.18 & \\
b_0 = & -\ 0.32 & \\
a_0 = & -\ 0.15 & +\ \ 0.21\ T_1 \\
\delta_0 = & 0.00 & -\ \ 0.12\ T_1 \\
\delta\varepsilon = & +\ 0.09 & -\ \ 0.40\ T_1
\end{array}\right\}\ \text{A}$$

$$\left.\begin{array}{lrr}
 & '' & '' \\
\delta\pi = & -\ 0.36 & +\ \ 7.83\ T_1 \\
\delta\text{☊} = & +\ 1.45 & +\ 11.84\ T_1 \\
\delta i = & -\ 0.19 & \\
b_0 = & -\ 0.36 & \\
\delta\varepsilon = & +\ 0.09 & -\ \ 0.43\ T_1
\end{array}\right\}\ \text{B}$$

The values of the moon's mean longitude, λ, longitude of perigee, π, and longitude of node, ☊, used by Hansen in his tables are given below. Hansen gives their values for the epoch 1800, Jan. 0.0 only. For convenience of reference their values for 1850, Jan. 0.0, and 1900, Jan. 0.0, are given in addition. The relation between λ, π, and ☊, and the quantities g, ω, and ☊, tabulated by Hansen, is well known and need not be stated here. Hansen uses:

$$\begin{aligned}
\lambda &= 335^\circ\ 43'\ 26''.70 + (1336^r + 1108\ 419''.61)\ T_0 + 13''.301\ T_0^2 + 0''.0135\ T_0^3 \\
\pi &= 225\ \ 23\ \ 53.06 + (\ \ \ 11 + \ \ 392\ 582.46)\ T_0 - 36.134\ T_0^2 - 0.037\ T_0^3 \\
\text{☊} &= \ \ 33\ \ 16\ \ 31.15 - (\ \ \ \ 5 + \ \ 482\ 939.61)\ T_0 + \ \ 8.189\ T_0^2 + 0.007\ T_0^3
\end{aligned}$$

$$\begin{aligned}
\lambda &= 123^\circ\ \ 5'\ \ 2''.31 + (1336^r + 1108\ 432''.92)\ T_1 + 13''.321\ T_1^2 + 0''.0135\ T_1^3 \\
\pi &= \ \ 99\ \ 51\ \ 54.74 + (\ \ \ 11 + \ \ 392\ 546.30)\ T_1 - 36.190\ T_1^2 - 0.037\ T_1^3 \\
\text{☊} &= 146\ \ 13\ \ 38.72 - (\ \ \ \ 5 + \ \ 482\ 931.41)\ T_1 + \ \ 8.200\ T_1^2 + 0.007\ T_1^3
\end{aligned}$$

$$
\begin{aligned}
\lambda &= 270^\circ\ 26'\ 45''.84+(1336^r+1108\ 446''.25)\ T_2+13''.341\ T_2^2+0''.0135\ T_2^3\\
\pi &= 334\ \ 19\ \ 38.30+(\ \ 11+\ 392\ 510.08)\ T_2-36.245\ T_2^2-0.037\ \ T_2^3\\
\text{☊} &= 259\ \ 10\ \ 50.38-(\ \ 5+\ 482\ 923.21)\ T_2+\ 8.210\ T_2^2+0.007\ \ T_2^3
\end{aligned}
$$

The various corrections to Hansen which we have found will now be collected. These corrections are of the form:

$$a_0+a_1T+a_2T^2+a_3T^3.$$

In Chapter IX, §47, we found:

$$
\begin{aligned}
\delta\pi &= -0''.97\ T_0^2-0''.0078\ T_0^3,\\
\delta\text{☊} &= -0.63\ T_0^2+0.0013\ T_0^3.
\end{aligned}
$$

Adding to these partial corrections the values obtained in solution (B) preceding, after reducing all of the corrections to the same epoch, and collecting the results, we obtain the results given below. The value of $\Delta\lambda$ is taken from §51, and needs no explanation. The results for all three epochs are given for convenience.

$$
\begin{aligned}
\Delta\lambda &= -\ 0''.31-26''.57\ T_0-4''.23\ T_0^2-0''.0067\ T_0^3;\\
\Delta\pi &= -\ 4.27+\ 7.82\ T_0-0.97\ T_0^2-0.0078\ T_0^3;\\
\Delta\text{☊} &= -\ 4.47+11.84\ T_0-0.63\ T_0^2+0.0013\ T_0^3;
\end{aligned}
$$

$$
\begin{aligned}
\Delta\lambda &= -14''.65-30''.81\ T_1-4''.24\ T_1^2-0''.0067\ T_1^3;\\
\Delta\pi &= -\ 0.60+\ 6.85\ T_1-0.98\ T_1^2-0.0078\ T_1^3;\\
\Delta\text{☊} &= +\ 1.29+11.21\ T_1-0.63\ T_1^2+0.0013\ T_1^3;
\end{aligned}
$$

$$
\begin{aligned}
\Delta\lambda &= -31''.12-35''.05\ T_2-4''.25\ T_2^2-0''.0067\ T_2^3;\\
\Delta\pi &= +\ 2.57+\ 5.86\ T_2-0.99\ T_2^2-0.0078\ T_2^3;\\
\Delta\text{☊} &= +\ 6.74+10.58\ T_2-0.63\ T_2^2+0.0013\ T_2^3.
\end{aligned}
$$

The final adopted values of the mean longitude of the moon, the longitude of the perigee, and of its node now become for the chosen epochs:

$$
\begin{aligned}
\lambda &= 335^\circ\ 43'\ 26''.39+(1336^r+1108\ 393''.04)T_0+\ 9''.07\ T_0^2+0''.0068\ T_0^3\\
\pi &= 225\ \ 23\ \ 48.79+(\ \ 11+\ 392\ 590.28)T_0-37.10\ T_0^2-0.045\ \ T_0^3\\
\text{☊} &= \ 33\ \ 16\ \ 26.68-(\ \ 5+\ 482\ 927.77)T_0+\ 7.56\ T_0^2+0.008\ \ T_0^3
\end{aligned}
$$

$$
\begin{aligned}
\lambda &= 123^\circ\ \ 4'\ 47''.66+(1336+1108\ 402''.11)T_1+\ 9''.08\ T_1^2+0''.0068\ T_1^3\\
\pi &= \ 99\ \ 51\ \ 54.14+(\ \ 11+\ 392\ 553.15)T_1-37.17\ T_1^2-0.045\ \ T_1^3\\
\text{☊} &= 146\ \ 13\ \ 40.01-(\ \ 5+\ 482\ 920.20)T_1+\ 7.57\ T_1^2+0.008\ \ T_1^3
\end{aligned}
$$

$$
\begin{aligned}
\lambda &= 270^\circ\ 26'\ 14''.72+(1336+1108\ 411''.20)T_2+\ 9''.09\ T_2^2+0''.0068\ T_2^3\\
\pi &= 334\ \ 19\ \ 40.87+(\ \ 11+\ 392\ 515.94)T_2-37.24\ T_2^2-0.045\ \ T_2^3\\
\text{☊} &= 259\ \ 10\ \ 57.12-(\ \ 5+\ 482\ 912.63)T_2+\ 7.58\ T_2^2+0.008\ \ T_2^3
\end{aligned}
$$

Principal elliptic term in longitude (Cowell): 22,639''.50 sin g.
Principal term in latitude: 18,461''.45 sin u.

The mechanical ellipticity of the earth.—Subducting the precessional motions from the movement of π and $☊$ in the values given above for the epoch 1850 we obtain the following values for the sidereal movements for a Julian year:

$$\pi_1 = +146\,435''.29 \pm 0''.02,$$
$$☊_1 = -\;69\,679.45 \pm 0.02.$$

These values, taken in conjunction with their theoretical values deduced by Brown furnish a value of the terms in the lunar theory due to the ellipticity of the earth, and therefore the mechanical ellipticity itself, which is probably as accurate as any obtainable. The terms due to this cause as deduced from the occultations become

$$\delta\pi_1 = +6''.49t; \qquad \delta☊_1 = -6''.13t.$$

The theoretical values deduced by Hill are:

$$\delta\pi_1 = +6''.82t; \qquad \delta☊_1 = -6''.41t.$$

From the values of $\delta\pi_1$, we find that Hill's value of

$$\mu = \frac{3}{2}\,\frac{1}{M}\left(C - \frac{A+B}{2}\right) = 0.0017595,$$

which enters as a factor into all the perturbations due to the earth's ellipticity, should be multiplied by $F=0.952$ in order to represent its observed value. Similarly from the observed value of $\delta☊_1$, the factor is found to be $F=0.956$, which is in very good agreement with the preceding. A third value of equally great weight can be deduced by comparing Hill's value of the principal ellipticity term in latitude with its observed value. There is, however, a difficulty in obtaining its value from observation, due to its entering into the moon's latitude in the same manner as the obliquity of the ecliptic. The obliquity must therefore be assumed as known with precision from observations of the sun. Assuming Newcomb's value of the obliquity for 1850 as correct, we deduce from the set of corrections (*c*), page 219, the following correction to Hansen's value:

$$\Delta\beta = +0''.09 \sin v.$$

Hansen used

$$\delta\beta = -8''.63 \sin v.$$

The observed value is, therefore,

$$\delta\beta = -8''.54 \sin v.$$

Subducting from this,

$$\delta\beta = -0''.23 \sin v,$$

due to the motion of the ecliptic and action of the planets, we obtain the following observed value of the principal term due to the earth's ellipticity:

$$\delta\beta = -8''.31 \sin v.$$

Hill's value is

$$\delta\beta = -8''.726 \sin v.$$

Comparison of these two values gives, therefore,

$$F = 0.952.$$

The agreement of these three entirely independent values of F which we have deduced, the total range in value being less than 1 per cent, is quite remarkable. Its mean value is

$$F=0.953.$$

The observed value of μ is, then,

$$\mu=0.001677.$$

There is no doubt that a better value for the observed principal inequality in latitude can be obtained after a rediscussion of solar observations, with especial reference to the obliquity of the ecliptic, has been made.

Addendum to Chapter XI.

Proceeding in regular course and assuming the theory to be complete, our final step in the present work would be to express the conclusions as to the values of the unknown quantities in terms of fundamental elements. But there are obstacles which prevent this being readily done. Among the most important of these elements is the factor depending upon the ellipticity and radius of gyration of the earth which determines the inequalities arising from the non-sphericity of the geoid. Hill determined the factor wholly by geodetic investigations, finding a markedly larger value than that derived by Helmert. But we may also determine the factor from the observed values of the several inequalities to which it gives rise. These are four in number:

1. The inequality in the moon's mean longitude depending on the longitude of the node.
2. The inequality in the moon's latitude produced by the same cause.
3. The motion of the node.
4. The motion of the perigee.

None of these four methods can be used to lead to a reliable result. The difficulty in the case of the longitude term in the ☊ arises from the irregular fluctuations in the moon's mean longitude, which make it impossible to separate these irregular changes from the regular inequality itself. In fact we shall find that, owing to this cause, the different values obtained for the coefficient of the ellipticity term are markedly discordant, the difference amounting to half a second or more.

The difficulty in the case of the latitude term is that practically it is combined with the obliquity of the ecliptic; that is to say, to determine it from observation we must have an independent knowledge of the obliquity. This, of course, we have, but not with a satisfactory degree of certainty. In other words, what we actually determine from observations of the moon is the value of $\varepsilon+\eta$, the latter being the latitude coefficient. Having found this sum we have to subtract ε in order to obtain η. Here we have an uncertainty of several tenths of a second owing to the difficulty of making an exact determination of the obliquity from observation. This difficulty is not encountered in the secular variation of the obliquity because the increment η is a constant. The value of $D_t\varepsilon$ which we have derived from our equations therefore correctly expresses the correction to the secular variation of ε because it seems to be the most reliable value of that variation with which observations supply us.

In the case of the node and perigee we have to make an exact theoretical determination of the secular motions of these two elements from pure theory, and assume that the excess of the observed motion over the theoretical one is due to the earth's ellipticity. From the rough determination I have made the result thus reached is fairly accordant with that reached in other ways, but it can not be called satisfactory.

In view of the reliability of the secular motion of the obliquity as we have derived it from occultations its magnitude may seem surprising; but there is an important action in play which may account for the discordance when fully investigated. This is the attraction of matter near the sun that causes the excess of motion of the perihelion of Mercury. The following is a statement of the question as it now stands. In my final discussion of the solar elements (Elements and Constants), I found that the motion of the perihelion of Mercury could be caused by a ring of matter, either between Mercury and Venus or inside the orbit of Mercury itself. The latter, of course, will be so much the more probable that it alone need be considered.

Had it been certain that the motion was due to this cause, I might well have constructed the solar and planetary elements by introducing the hypothesis of this ring. As simplicity in the theory was a prime requisite, and the elements of the supposed ring were affected by such an uncertainty that I did not desire to see them made a basis of the theory of the sun, I therefore provisionally adopted the hypothesis that gravitation was not exactly as the inverse square, which had the advantage of great simplicity, leading, should it be wrong, to a very easy method of correcting the theory by future investigators.

After the publication of my tables, Brown's completed determination of the theoretical motion of the lunar perigee showed that the gravitation of the earth did not differ from the Newtonian law and the same thing was true presumptively of that of the sun. We were thus forced back upon the hypothesis of a mass of matter surrounding the sun sufficient to cause the motion of the perihelion of Mercury.

The next step forward was taken by Seeliger, who sought to identify the matter in question with that of the zodiacal light, and showed that by assuming an ellipsoidal mass the motion of the perihelion of Mercury and the other secular variations could be represented.

This hypothesis of Seeliger has been somewhat misapprehended. In its essential results it does not differ materially from my own hypothesis of an intramercurial ring. In fact, a comparison of Seeliger's elements with my ring elements will show a close approach to identity in the position of the plane containing the ellipsoidal mass.

More important yet is the fact that the matter of Seeliger's hypothesis is not really identical with that of the zodiacal light because it is too near the sun to be visible. In other words, nothing that we know of the figure of the zodiacal light would be compatible with Seeliger's ellipsoid. The latter is therefore to be regarded as an independent hypothesis, the matter of the zodiacal light not coming into play at all. At the same time I freely admit that the hypothesis of the ellipsoid is more probable than that of the ring, and therefore prefer Seeliger's form to my own.

We now reach a critical point in the whole discussion. All my determinations of the elements were made on the hypothesis that the motion of the perihelion of Mercury was not caused by the attraction of matter. Introduce this matter as an attracting body and we have a new set of secular variations, especially of the node of Venus. This may well be the reason why the value of the solar parallax which I derived from the node of Venus, notwithstanding its seeming certainty, is abnormally small.

It is therefore necessary to the completion of the results of the present paper that the secular motions of the elements, including the obliquity, be completely rediscussed.

CHAPTER XII.

DISCUSSION OF NARRATIVES OF ANCIENT ECLIPSES OF THE SUN.

SECTION I.

57. A total eclipse of the sun is so impressive a phenomenon, especially as presented to the minds of the ancients, who supposed celestial phenomena to be intimately associated with the destiny of men and nations, that the number of narratives of such eclipses found in ancient records seems notably small. Ginzel's charts show that between B. C. 700 and A. D. 200, 14 total eclipses of the sun were visible in Greece or its neighborhood and several others in regions outside of Greece where we should have su[illegible]hey would have been noticed and recorded by Greek or Roman historians. The number of an[illegible]r eclipses is of course yet greater. Of these 30 or 40 striking eclipses only 5 have yet been identified with the narratives of historians, and in at least one of these cases the identification is doubtful. In this enumeration I have omitted several passages which have been supposed with [illegible] greater or less degree of probability to have referred to eclipses, but in which no identification is possible. Saying nothing of eclipses passing through more distant regions, which might well have been recorded, we find nine unrecorded total eclipses against four probably identified ones and one of doubtful identity.

The mass of literature relating to the subject of total eclipses during the period in question is so great that no detailed discussion and comparison of conclusions seems necessary in the present chapter. The author will therefore content himself with a résumé of the questions at issue.

He must admit at the outset that his views of the usefulness of the narratives in question as tests of the lunar tables may seem at first sight to differ so widely from those of nearly all other commentators as to require some explanation or defense. Naming only those authors who expressly or impliedly repose confidence in the results to be derived from the sources in question we have Hansen, Airy, Oppolzer, Ginzel, and Cowell, not to mention other writers who have touched on special points. So far as the author is concerned, it might at first sight seem that the authorities in favor of the material in question must far outweigh that of a single authority treating the material as practically valueless except for historic purposes. But, in order that the authorities may have weight as such, it is necessary that they should agree as to their conclusions. When we apply this test to their works we can scarcely be said to find agreement between any two, but rather conclusions of the most contradictory kind. An exceptional case of agreement may be that of Airy and Hansen; but their work had for its purpose rather to show that Hansen's tables represented the ancient eclipses than to derive any new conclusions from them. Ginzel and Oppolzer agree in deriving from the eclipses corrections to the elements of the mean moon's motion which are incompatible both with gravitational theory and with modern observations. So high are these authorities that if they agreed as to the corrections we might inquire whether greater weight should be assigned to modern observations than to the eclipses in question. But, as a matter of fact, we find no agreement as to the corrections which the modern tables require in order to represent the eclipses.

What the author now proposes to do is to repeat, so far as is necessary, his examination of ancient solar eclipses found in his Researches of 1878, in the light of more recent developments on the side both of observation and theory. The fundamental principles on which the treatment is based are so obvious as to need no detailed statement. The only fact of history on which any conclusion can be based is that an identifiable total eclipse of the sun was seen to be total at a well-defined spot on the earth's surface. The mere fact of totality does not suffice unless the place where this phase was observed is established, nor does the place suffice unless the narrative inspires confidence that the total phase was actually observed at that place, and that the narrative does not refer to an observation of totality made elsewhere.

Granting that a narrative sustains this test, the next question to arise will be what conclusions are to be drawn from the fact of totality. In our ignorance of the time of the observed phase all that can be deduced from any one observation is an equation of condition between the corrections to the elements which will represent the phenomenon of totality. The question to be considered is, therefore, what elements we are to consider as subject to correction.

It needs no argument to show that the moon's mean longitude at the time is the most uncertain element, and therefore the one first to be considered. The mean motion is so well determined from modern observations that the correction to the mean longitude needs to be expressed only as that to the secular acceleration.

Next in order comes the correction to the longitude of the moon's node. The necessity of including this correction will depend upon whether we consider the longitude of the node to be sufficiently well determined from gravitational theory and modern observations. Formerly the uncertainty on this point was such that a correction to the node could well be included in the conditional equations. But at the present time it seems to me that, although it may be well to know what effect a change in the position of the node may have upon the phenomenon, we can scarcely correct its longitude by ancient eclipses, and this for the following reasons: The researches of Brown have shown that the motions of the perigee and node of the moon during the last 250 years are in as precise accordance with the Newtonian law of gravitation as the uncertainty of our data permits. Of the latter the ellipticity of the geoid is the principal uncertain element. The presumption is very strong that this accordance of the motion with the law of gravitation is a permanent feature of the moon's motion. Accepting this, it follows that the secular acceleration of these elements and, therefore, their values in ancient times, can be determined with all necessary precision by gravitational theory combined with modern observation. The actual centennial motion is to be determined from observations alone. The secular acceleration is easily determined by theory, as already shown.

The motion of the sun in longitude is now so well determined that it might appear quite superfluous to consider its correction by material so uncertain as that before us. But Mr. Cowell has sought to reconcile the most reliable ancient eclipses with gravitational theory and modern observation by assuming a secular acceleration of about $4''$ in the sun's mean longitude. The probability of this need not be discussed in the present connection; but it is quite easy to include as an unknown quantity the correction to the sun's longitude in the conditional equations.

Proceeding as in former Researches we shall begin with a short study of the several narratives with a view of forming some idea beforehand how reliable each may be supposed. But it is not necessary to analyze critically the original passages, as was done in the former Researches.

58. (A) *Babylonian eclipse of −1062, June 19.*—For the account of this eclipse I depend upon Mr. Cowell's paper in the Monthly Notices R. A. S., Vol. LXV. We learn from this that Mr. L. W. King, of the British Museum, made a translation of a Babylonian record, reading as follows:

"On the 26th day of the month Sivan in the seventh year, the day was turned into night and fire in the midst of heaven."

Mr. Crommelin adds that the inscription from which this is an extract is a record of omens occurring in the city of Babylon—wild beasts entering the streets, dogs entering the temple, etc.

The author confesses his inability to see that this account should be considered as evidently referring to an eclipse of the sun, or if so, how it can be confidently regarded as having been total at Babylon. An unusual darkness from meteorological causes, popularly characterized as being as dark as night, is more common than total eclipses of the sun. If the entrance of animals into the temple was an important omen, so might also be any unusual darkness. It also seems to me that, granting an eclipse of the sun, the critical care implied in not recording it unless it was absolutely total and omitting to take account of it if the statement regarding it was brought in by couriers from other regions, is not implied in what we know of the human mind in ancient times. "Fire in the midst of heaven" may well have been a description of the corona, but it may also have been suggested by other phenomena. It is also to be remarked that there is a range of half a century in the possible time of the occurrence. The year − 1062 was chosen because it was the only one in which an eclipse could have been total near Babylon.

Under these circumstances it is well worth while to inquire whether, according to modern data, the eclipse could have been total at Babylon. If so, it will be admissible to inquire what correction to the moon's mean longitude is implied at that time.

(B) *Eclipse of Nineveh, − 762, June 4.*—I quote the statement respecting this eclipse given by Mr. Cowell which, as translated from the inscription, is in the words: "In the month of Sivan the sun underwent an eclipse." I do not know how certain the identification of this eclipse is, but as the date seems to have been accepted by all who have alluded to the subject I assume that there is no doubt.

It is noteworthy that we have not the slightest intimation in the statement that the eclipse was total at Nineveh or anywhere else. The tables show that on the date assigned the shadow of the moon passed some two degrees north of Nineveh. In view of the rapid and constant intercommunication between different parts of the empire there can be no doubt that the fact of a total eclipse was reported at the capital and duly recorded. Under these circumstances I see no strong reason for assuming that the total phase passed over Nineveh, but rather the contrary, because in this case something would probably have been said about the darkness. In deference to the opinion of others on the subject, I shall, however, determine what changes in the lunar elements will bring the path south to Nineveh.

(C) *Eclipse of Archilochus, − 647, April.*—In the writings of the poet Archilochus, who is supposed to have flourished some time in the seventh century B.C., is found the passage (Archilochus, frg. 74 [Bergk]):

> *Χρημάτων ἄελπτον οὐδέν ἐστιν οὐδ᾽ἀπώμοτον οὐδὲ θαυμάσιον, ἐπειδὴ Ζεὺς πατὴρ Ὀλυμπίων ἐκ μεσημβρίης ἔθηκε νύκτ᾽ ἀποχρύψας φάος ἡλίου λάμποντος λυγρὸν δ᾽ ἦλθ᾽ ἐπ᾽ ἀνθρώπους δέος.*

I am indebted to Prof. Mitchell Carroll, of the George Washington University, for the following translation of the passage:

> Of events not one is unexpected nor impossible nor wonderful, since Zeus, father of Olympus, out of high noon has made night, concealing the light of the shining sun; but baneful terror has come upon mortals.

From this it may fairly be inferred that Archilochus at some time in his life either witnessed a total eclipse of the sun or heard about one from those who had witnessed it. It may be supposed that the former is the more probable alternative, yet the presumption in favor of it is not strong. Of course, if he based his remarks upon the reports of others, no conclusion as to the path of totality could be drawn from what he says. Assuming that he was an eyewitness, the question is, where and when he made his observation. The only way in which the eclipse can be identified is by finding one which probably occurred during the early or middle life of the poet at the place where he lived.

So far as I have looked into the historical evidence, although it seems to be generally accepted that during several years of his life Archilochus lived on the island of Thasos, the doubt as to the date of his birth and death is such that we can not be at all confident that he lived on the island at the date in question. Even granting that he did, as Thasos is separated from the mainland by a strait only five miles in breadth, he might well have seen the eclipse as a nearly total one and heard of the totality from dwellers on the mainland. The presumption that the shadow actually passed over Thasos is, therefore, rather weak, unless strengthened by coincidence with other eclipses.

The only eclipse that could have fulfilled the conditions is that of −647. Our conclusion must, therefore, rest on the following combination: (1) that the poet actually referred to a total eclipse of the sun; (2) that he saw the eclipse himself; (3) that he was living at the time on the island of Thasos. A possibility of some element in this combination failing is such that I have little confidence in any conclusion to be drawn from the eclipse.

(D) *Eclipse of Thales, −584, May 28.*—I have discussed the evidence for this celebrated eclipse with so much fullness in former researches[a] that nothing need be added on the lines there followed. Among other difficulties in using the eclipse was the obvious fact that if the change of day into night was really due solely to it, night must have been changed back into day almost immediately, a fact of which the historian says nothing, and the contrary of which is implied by the whole narrative. It is all the less necessary to rediscuss the question because all the difficulties in interpreting the narrative are cleared up by the computation of the shadow path from modern data which is found in the introduction to my paper on the recurrence of eclipses. The total phase came on some 15 or 20 minutes after sunset, a circumstance corresponding remarkably with the narrative of Herodotus. Moreover, as the total phase passed and the sun grew brighter, its continually increasing depression below the horizon might have made the seeming night almost permanent, and led to the result described by Herodotus. There can be little doubt that Thales predicted this eclipse; in fact, it is probable that this was the only one he could have predicted.

While these considerations seem to clear up the whole question, they leave it evident that no use can be made of the eclipse for correcting the astronomical tables.

(E) *Eclipses of −462 and −430.*—The first of these is one of the eclipses, the absence of which from recorded history may well appear remarkable. It is true that a passage in Valerius Maximus states that during the time of Pericles there was an eclipse of the sun which threw Athens into darkness and terrified the inhabitants. Their fear was allayed by Pericles, who explained the theories of Anaxagoras on the subject. But researches by Mr. Fotheringham[b] show that the eclipse must have been that of −430; in fact, it seems that Valerius Maximus really borrowed from Cicero in whose De Republica I, 16, we find the passage:

> Atque eius modi quiddam etiam bello illo maximo, quod Athenienses et Lacedæmonii summa inter se contentione gesserunt, Pericles ille, et auctoritate et eloquentia et consilio princeps civitatis suæ, cum obscurato sole tenebræ factæ essent repente Atheniensiumque animos summus timor occupavisset, docuisse cives suos dicitur id quod ipse ab Anaxagora, cuius auditor fuerat, acceperat, certo illud tempore fieri et necessario, cum tota se luna sub orbem solis subiecisset; itaque, etsi non omni intermenstruo, tamen id fieri non posse certe nisi intermenstruo tempore. Quod cum disputando rationibusque docuisset, populum liberavit metu; erat enim tum hæc nova et ignota ratio, solem lunæ oppositu solere deficere quod Thaletem Milesium primum vidisse dicunt.

What is remarkable about this passage is that one would suppose that nothing but a total eclipse could have produced such fear among the Athenians. And yet the allusion to the Peloponnesian war, which did not commence until −431, seems to show with entire certainty that the eclipse alluded to is the annular one of −430, August 3, which is known as the eclipse of Athens, and which may well give rise to interesting discussion. The well known description by Thucydides II, 28, is translated as follows:

> But in the same manner, at the new moon of the month, as in that time alone it seems possible for the phenomenon to occur—the sun was eclipsed after midday, and having assumed a crescent form, some of the stars having also appeared, it again became full orbed.

I believe that Thucydides has the reputation of being the most careful and exact of the Greek historians. He is writing of events of which he was a witness; he was in Athens at the time of the eclipse, and it seems to be as certain as anything in his history can be that the eclipse alluded to is the one just mentioned.

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[a] Washington Observations for 1875, Appendix II; Astronomical Papers of the American Ephemeris, Vol. I.

[b] Observatory, December, 1908.

Now, the curious fact is that according to the tables the eclipse was not total anywhere, but only annular, and the path of the annular eclipse passed centrally through the Black Sea some 200 miles from Athens, less than an hour before sunset, so that there was no time for the sun to have again become full-orbed before it set. But the fact that the stars are said to have appeared would indicate a total eclipse. It has been suggested by some writers that planets, especially Venus, might have been visible. As Venus can be easily seen within an hour of sunset, even when there is no eclipse, this would offer no difficulty except for the use of the plural. The starlike objects next brightest were Mercury and Mars, but I do not think that either of these could have been seen even during the annular phase.

From Mr. Fotheringham's study it appears that this eclipse must have been the one referred to by Cicero in terms so strong. It might therefore appear that the fact of totality at Athens is better made out than in the case of any other ancient eclipse seen at a definite point. This evidence is weakened only by the point that in his actual description Thucydides says nothing to indicate that the eclipse was total except his allusion to the stars, nor does he allude to any fear being among the inhabitants.

Still, it will be of great interest to determine what changes in the lunar elements would make this eclipse annular at Athens, and a further discussion of the subject may be deferred until we have made the comparison with the tables.

(F) *Eclipse of Agathocles, −309, August 14.*—This eclipse is completely identified with that observed by Agathocles, whose description would leave no reasonable doubt of totality. If any correction of the lunar elements could be based upon it, it would be the best of all the ancient ones for our purpose. But there are two circumstances which prevent this. In the first place, Agathocles was at sea and his position is doubtful. Secondly, the shadow path was so broad that even if we knew precisely where Agathocles was, no admissible changes in the tables would throw him outside the shadow unless he were near one border. Apart from this, the eclipse has been so thoroughly discussed by Airy and others that nothing more need be said of it in the present connection, although we shall have occasion to refer to it later.

(G) *Eclipse of Alexandria and the Hellespont, −128, November 20.*—This eclipse differs from all his others in that no date of the occurrence is recorded, but the circumstances of the eclipse are described with a degree of precision unequaled in any other ancient record. What is actually known is that the eclipse was total in the Hellespont and four-fifths covered at Alexandria. The three authorities by whom it is mentioned are cited and discussed with such fullness by Celoria[a] and later by Fotheringham[b] that it does not seem necessary to enter into details. Celoria undertook an exhaustive examination of all the eclipses within the period during which the eclipse in question might have occurred, basing his conclusions on Hansen's tables. The only one he found fulfilling the conditions was that of Agathocles, in −309. Afterwards Doctor Hultsch proposed to identify it with the eclipse of −128, November 20.

A careful examination showed that the eclipse was probably used by Hipparchus, and therefore occurred during the time of his activity. This renders the date last mentioned the only admissible one. We may therefore say with more confidence than in the case of any other central eclipse of antiquity that the eclipse of −128, November 20, was total in the Hellespont, while the sun was only four-fifths covered at Alexandria.

(H) *Eclipse of Utica, 197, June 3.*—We quote the following passage of Tertullian, at Scapian, chapter 3, from Mr. Cowell:

> Nam et sol ille in conventu Uticensi, extincto pæne lumine, adeo portentum fuit, ut non potuerit ex ordinario deliquio hoc pati, positus in suo hypsomate et domicilio. Habetis astrologos.

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[a] Memorie della Classe di scienze fisiche, matematiche e naturali, Serie 3, Vol. VII, R. Accademia dei Lincei, Seduta del 7 marzo, 1880.

[b] Monthly Notices, R. A. S., Vol. LXIX, p. 204, January, 1909.

The tables show this eclipse to have been really annular though almost total. As Tertullian describes the eclipse only as nearly total, "extincto pæne lumine," there is a wide range of uncertainty as to the formation of the annulus. Any correction that can be derived from it will therefore be doubtful.

Possible Total Eclipses of Doubtful Identity.

59. There are a number of passages in the classical authors which may be supposed with more or less probability to have referred to total solar eclipses, which, however, prove incapable of certain identification. One of the most curious of these is the supposed eclipse of Xerxes, of which the time and place would seem to be more certainly fixed than in the case of any other. The place was near Sardis, the time between −477 and −480. What is remarkable is that the eclipse is described by two writers, both practically contemporaneous with the event.

Herodotus states that the sun, leaving his seat in the heavens, was concealed from view, and night instead of day came on, though the weather was not cloudy, but exceedingly clear.

Aristides states that there happened an eclipse of the sun in the east, which foretold to Xerxes his defeat, because the sun was eclipsed in the region of its rising, the direction from which Xerxes was marching.

No possible eclipse of the sun could have given rise to these two statements. The latter are therefore available only as an index to the degree of confidence with which we can assign any precise interpretation to the statements of ancient historians on the subject. It is quite unnecessary for our present purpose to discuss the numerous suggestions as to what the passages may have referred, because in any case the eclipse will be useless for our purpose.

A supposed eclipse at Larissa has been made celebrated through its discussion by Airy, who assigns the date −556. The author is Xenophon. Nothing but doubt has been thrown upon the whole subject of this eclipse by recent researches, which is heightened by the doubt whether the passage referred to an eclipse at all, and, if it did, whether the year −556 is possible.

The several other narratives quoted by Hansen to support his value of the secular acceleration it does not seem necessary to discuss, since they have been discussed at great extent by several recent authors without any result being reached on which a definite correction can be based.

The question may still arise as to the possible value of mediæval total eclipses. Ginzel has collected a great number of observations of this class, and Celoria, in a well-known paper, has discussed those of 1140 and 1143. What is especially worthy in this discussion is that the limits of the shadow path are determined from the statements of observers by judging in each case whether the eclipse was or was not seen as a total one.

Comparison with the tables shows that no admissible values of the elements of the moon's mean motion will give the limits of the path as mapped by Celoria.

The author has also made a careful study of Ginzel's eclipses with a view to determining whether in any case it could be judged with a fair degree of confidence that what any of the narrators saw was undoubtedly the total phase. If he found any such cases, they were too few to base any conclusions upon. He frankly admits that on this point he differs widely from the views of his fellow astronomers who have examined the same data, especially of Ginzel. The corrections derived by the latter from the totality of the mediæval eclipses as found in his Kanon der Finsternisse diverge greatly from the results of modern observations. Notwithstanding the high authority of so careful a student, the writer feels himself compelled to hold that when the question is whether the modern observations of Greenwich and Paris are in error by large fractions of a minute of time, or whether deductions from the narratives of mediæval authorities are reliable when we attempt to interpret them with entire precision, his own judgment is in favor of the modern observations, combined with gravitational theory. That the results of each author were widely divergent both from mean observations and gravitational theory, was not, it seems to me, given its due weight.

The maps of Oppolzer's Canon are defective principally from the rough method of delineating the path of central eclipse upon the earth. This was done by computing the noon point, and that of beginning and ending, and then drawing an arc of a circle upon the map through these three points. As the true path when projected upon the map scarcely ever approximates to the arc of a circle, the result is that although the noon point and the two extremes are correct according to the formulæ used, the intermediate portions of the path are frequently in error by 400 or 500 miles. This error might have been reduced by the very slight modification of computing the direction of the tangent to the path at the noon point, and then representing the path before and after this point by arcs of circles tangent to the actual path at the noon point. Although the path would not even then have been precise, it would have been much nearer the truth than is the one actually drawn.

In Ginzel's maps this defect does not exist, every path being laid down with entire precision according to his tabular elements.

SECTION II. DISCUSSION OF OPPOLZER'S TABLES OF ECLIPSES.

60. To compare ancient eclipses with theory, I have made use of Oppolzer's eclipse tables, applying the corrections necessary to reduce their elements to those of the concluded theory. These tables are constructed on a very convenient plan worked out by Hansen. They include only the larger inequalities in the motion of the moon and omit the periodic inequalities of the sun's longitude. The effect of these omissions on the circumstances of an eclipse is too small to be of importance in the discussion of the historical eclipses. The principal points in the construction of these tables are the following:

1. The moment of mean conjunction of the sun and moon in ecliptic longitude is tabulated.
2. The arguments with which the tables are entered have the values corresponding to this moment of mean conjunction, and are therefore readily computed and checked.
3. The theory is so constructed and transformed that the quantities tabulated are the reductions to the moment of true conjunction in longitude, and the values of the principal eclipse elements for the latter moment.
4. With the elements thus determined the circumstances of the eclipse are computed in the usual way, assuming the motions during the eclipse to remain unchanged from their value at true conjunction.
5. The elements tabulated on this system are ecliptical, not equatorial; some reductions to the equator are therefore necessary. The method of making this reduction is given at some length by Oppolzer, but I have found it more convenient to reduce the ecliptical coordinates of the axis of the shadow to the equator, thus using the Besselian coordinates in the further computations.
6. Oppolzer tabulates certain empirical corrections to his arguments, but does not, so far as the writer is aware, give any statement of the grounds on which they are based. As they are inconsistent both with gravitational theory and modern observations, I have ignored them, and reduced the elements to the concluded theory of the present work.

Correction of Oppolzer's Tables.

61. The elements on which Oppolzer's tables are based are Hansen's tables of the moon and Leverrier's of the sun. But the lunar elements of mean motion have received the following modifications:

The longitude of the node receives the correction

$$\Delta\text{☊} = -5''.5 + 11''.0\,\mathrm{T}.$$

The lunar perigee remaining unchanged, Oppolzers's virtual correction of ω is

$$\Delta\omega = +5''.5 - 11''.0\,\mathrm{T}.$$

2. The secular accelerations which Oppolzer adopts are those of Hansen's Darlegung, which compare with those of Hansen's tables as follows:

	Hansen's Tables.	Oppolzer (Darlegung).	Oppolzer—Tables.
	″ ″	″ ″	″ ″
$\Delta_2 g$	$=+49.435T^2+0.05007T^3$	$+51.134T^2+.05115T^3$	$+1.699T^2+.00108T^3$
$\Delta_2 \omega$	$=-44.323T^2-0.04376T^3$	$-45.200T^2-.04521T^3$	$-0.877T^2-.00145T^3$
Δ_2☊	$=+\ 8.189T^2+0.00716T^3$	$+\ 7.744T^2+.00662T^3$	$-0.445T^2-.00054T^3$
$\Delta_2 \lambda$	$=+13.301T^2+0.01347T^3$	$+13.678T^2+.01256T^3$	$+0.377T^2-.00091T^3$

The corrections required are those to Oppolzer. I accept his centennial motions of π and ☊, and therefore of ω, for the epoch 1800, but correct the terms in T^2 and T^3. These terms as corrected compare with those of Oppolzer as follows:

	N.	N−O.
	″ ″	″ ″
$\Delta_2 g$	$=+46.171T^2+.0518T^3$	$-4.963T^2+.0006T^3$
$\Delta_2 \omega$	$=-44.66\ T^2-.053T^3$	$+0.540T^2-.0078T^3$
Δ_2☊	$=+\ 7.56\ T^2+.008T^3$	$-0.184T^2+.0014T^3$
$\Delta_2 \lambda$	$=+\ 9.071T^2+.0068T^3$	$-4.607T^2-.0058T^3$

These corrections are applicable to the body of Oppolzer's tables. They affect only the times of mean conjunction and the arguments with which the tables are entered.

The corrections of the arguments are of two classes, the one that of the moving elements at any given time; the other the reduction to the actual time of true conjunction in longitude.

The term in T of reduction of Oppolzer's mean longitude of the moon to that of the present theory is the same as for Hansen's tables. The entire reduction, N−O, is,

$$\delta\lambda=-0''.3-26''.57T-4''.607T^2-0''.0058T^3.$$

In my new Tables of the Sun for 1900, Leverrier's mean longitude has received the correction

$$\delta L=-0''.36-0''.78T-0''.018T^2.$$

Thus we have, for the correction to Oppolzer, $\lambda-L$,

$$\delta(\lambda-L)=-25''.79T-4''.589T^2-0''.0058T^3.$$

We now put τ for the time of mean conjunction, called T by Oppolzer. Then $\Delta\tau$ is the time required for $\lambda-L$ to move through the arc $\delta(\lambda-L)$. Putting λ_1 and L_1 for the daily motions of λ and L, we have

$$\Delta\tau=\frac{\delta L-\delta\lambda}{\lambda_1-L_1}.$$

We have

$$\lambda_1=13^\circ.176,$$
$$L_1=\ 0^\circ.986.$$

Hence,

$$\Delta\tau=\frac{25''.79T+4''.589T^2+0''.0058T^3}{12^\circ.190},$$

and

$$10^4\Delta\tau=5.^d877T+1^d.0458T^2+0^d.0013T^3.$$

The arguments of the tables are all given for the moment of mean conjunction. Their corrections therefore consist of two parts:

1. The correction at a given moment, as already found.
2. The reduction for the interval $\Delta\tau$.

We represent these two corrections by the symbols δ and δ_1.

Since Hansen's centennial motion of the perigee is retained without change, the term of g factored by T is the same as for λ. We therefore have for the correction of g,

$$\delta g = -26''.57\mathrm{T} - 4''.963\mathrm{T}^2 + 0''.0006\mathrm{T}^3.$$

In degrees

$$10^4\delta g = -73^\circ.80\mathrm{T} - 13^\circ.786\mathrm{T}^2 + 0^\circ.0017\mathrm{T}^3.$$

For the sun's mean longitude

$$10^4\delta L = -2^\circ.17\mathrm{T} - 0^\circ.050\mathrm{T}^2.$$

For the sun's mean anomaly Oppolzer used Leverrier's value [illegible]

$$g' = g'_0 + (100^r - 3401''.40)\mathrm{T} - 0''.7157\mathrm{T}^2. \text{ --- where } g'_0 = 0^\circ 24' 31''.86 \text{ (1800...}$$

The value in my Tables of the Sun is

$$g' = g'_0 + (100^r - 3419''.86)\mathrm{T} - 0''.50\mathrm{T}^2. \text{ --- where } g'_0 = 0^\circ 24' \underline{41}.55 \text{ (1800...}$$

Dropping the constant term for 1800 the result is:

Hence the constant term for 1800 considerable to be "dropt" ... being $+9''.69$, or, in $10^4 g$

$$\delta g' = -18''.46\mathrm{T} + 0''.22\mathrm{T}^2,$$

giving

$$10^4\delta g' = -51^\circ.3\mathrm{T} + 0^\circ.61\mathrm{T}^2. \ \underline{+26^\circ.917}$$

Oppolzer's motion for the node for 1900 being also retained, we have

$$10^4\delta\Omega = -0^\circ.51\mathrm{T}^2 + 0^\circ.004\mathrm{T}^3$$
$$10^4\delta\omega = +1^\circ.50\mathrm{T}^2 - 0^\circ.021\mathrm{T}^3.$$

For the corresponding reductions for $\Delta\tau$ we have the daily motions

$$\begin{aligned} g_1 &= 13^\circ.065, \\ g'_1 = L_1 &= 0.9856, \\ \omega_1 &= 0.1644, \\ \Omega_1 &= -0.0530. \end{aligned}$$

The product of these into $\Delta\tau$ gives the following:

$$\begin{aligned} 10^4\delta_1 g &= +76^\circ.78\mathrm{T} + 13^\circ.666\mathrm{T}^2 + 0^\circ.0144\mathrm{T}^3, \\ 10^4\delta_1 L &= +\ 5.792\mathrm{T} + \ 1.031\mathrm{T}^2 + 0.0011\mathrm{T}^3, \\ 10^4\delta_1 \omega &= +\ 0.966\mathrm{T} + \ 0.172\mathrm{T}^2 + 0.0002\mathrm{T}^3, \\ 10^4\delta_1 \Omega &= -\ 0.312\mathrm{T} - \ 0.056\mathrm{T}^2, \\ \delta_1 g' &= \delta_1 L. \end{aligned}$$

Adding these to the values of δg, etc., we have the entire corrections:

$$\begin{aligned} 10^4\Delta g &= +\ 2^\circ.98\mathrm{T} - 0^\circ.120\mathrm{T}^2 + 0^\circ.016\mathrm{T}^3, \\ 10^4\Delta L &= +\ 3.62\mathrm{T} + 0.981\mathrm{T}^2 + 0.001\mathrm{T}^3, \\ 10^4\Delta\omega &= +\ 0.97\mathrm{T} + 1.67\mathrm{T}^2 - 0.021\mathrm{T}^3, \\ 10^4\Delta\Omega &= -\ 0.31\mathrm{T} - 0.57\mathrm{T}^2 + 0.004\mathrm{T}^3, \\ 10^4\Delta g' &= -45.51\mathrm{T} + 1.64\mathrm{T}^2 + 0.001\mathrm{T}^3. \end{aligned}$$

The corrections to Oppolzer's P and Q are each equal to that of $g+\omega$. Hence

$$10^4\Delta P = 10^4\Delta Q = +3^\circ.95\mathrm{T} + 1^\circ.55\mathrm{T}^2 - 0^\circ.005\mathrm{T}^3.$$

Oppolzer's arguments I–VIII are expressed in units of $0^\circ.9$. The expressions for the arguments and corrections thus arising are:

$$\begin{array}{rll}
\text{Arg. I}=g & 10^4\Delta\text{I} & =+\ 3^\circ.3T-0^\circ.13T^2+0^\circ.018T^3 \\
\text{II}=g' & 10^4\Delta\text{II} & =-50.6T+1.82T^3 \\
\text{III}=2g'+2\omega' & 10^4\Delta\text{III} & =+\ 8.0T+2.2T^2 \\
\text{IV}=g-g' & 10^4\Delta\text{IV} & =+53.9T-2.0T^2 \\
\text{V}=g+g' & 10^4\Delta\text{V} & =-47.3T+1.7T^2 \\
\text{VI}=\Omega & 10^4\Delta\text{VI} & =-\ 0.3T-0.6T^2 \\
\text{VII}=2g-g' & 10^4\Delta\text{VII} & =+57.2T-2.1T^2 \\
\text{VIII}=2g+g' & 10^4\Delta\text{VIII} & =-44.0T+1.6T^2
\end{array}$$

These corrections are to be used in place of the "Empirische Correctionen," which Oppolzer prefixes to his tables. They are so readily computed that the exhibit of the following values, for intervals of 500 years, will answer our present purpose.

Year	T	$\Delta\tau$	ΔL	$\Delta P=\Delta Q$	ΔI	ΔII	ΔIII	ΔIV	ΔV
		d	°	°	°	°	°	°	°
−1200	−30	+0.0795	+0.080	+0.117	−0.07	+0.31	+0.2	−0.3	+0.3
−700	−25	+0.0524	+0.054	+0.081	−0.05	+0.24	+0.1	−0.3	+0.2
−200	−20	+0.0310	+0.033	+0.051	−0.03	+0.17	+0.1	−0.2	+0.2
+300	−15	+0.0151	+0.017	+0.028	−0.01	+0.12	0.0	−0.1	+0.1
800	−10	+0.0047	+0.006	+0.011	−0.01	+0.07	0.0	−0.1	+0.1
1300	−5	−0.0004	−0.001	+0.002	0.00	+0.03	0.0	0.0	0.0
1800	0	0.0000	0.000	0.000	0.00	0.00	0.0	0.0	0.0

The corrections to the other arguments seem to be unimportant.

Theoretical precision requires that the secular variation of the earth's eccentricity be reduced to the modern value. Leverrier's value for 1850 is $-8''.755$. The modern value is $-8''.595$. The numbers factored by τ in Oppolzer's tables should therefore be diminished by 0.0183 of their amount. The effect of this correction has been omitted in the work. The maximum effect on τ for the ancient eclipses is $0^d.0002$.

62. It may be of interest to compare the preceding with Oppolzer's empirical corrections, as given on his pages 15 and [4] and [5]. His $\Delta\tau$ agrees closely with my own, being in my notation,

$$10^4\Delta\tau=+6^dT+0^d.9T^2+0^d.0009T^3.$$

This corresponds to

$$\Delta\lambda=-26''T-3''.9T^2-0''.0039T^3.$$

His $\Delta L'$, as tabulated, is the reduction of L' for $\Delta\tau$, or what I term $\delta_1 L$. As my δL is small, this differs little from my value.

The case is different with Δg and $\Delta\omega$. The values of these quantities cited by Oppolzer on his page 15 may be written

$$\begin{aligned}
10^4\Delta(g+\omega)&=-190^\circ T-\ 4^\circ T^2-0^\circ.004T^3,\\
10^4\Delta g\quad&=\qquad\qquad +30^\circ T^2+0^\circ.03\ T^3,
\end{aligned}$$

from which follows

$$10^4\Delta\omega=-190^\circ T-34^\circ T^2-0^\circ.034T^3.$$

But when we compare the result of computation with these expressions with Oppolzer's tabulated corrections we find that, while $\Delta(g+\omega)$ agrees and gives ΔP and ΔQ, as it should, this is not exactly the case with Δ Arg. I, the equivalent of g. The expression in sexigesimal degrees, in fact, is used as centesimal degrees, without division by 0.9. It follows that, so far as results are concerned, the tabulated correction is

$$10^4 \Delta g = 27^{\circ}.0T^2 + 0^{\circ}.027T^3,$$

which will give

$$10^4 \Delta\omega = -190^{\circ}T - 31^{\circ}.0T^2 - 0^{\circ}.03T^3.$$

These corrections are those for the mean conjunction. To pass from them to the actual corrections at a given time we have the relation

$$\delta = \Delta - \delta_1.$$

Using Oppolzer's $\Delta\tau$ we shall have

$$\begin{aligned} 10^4 \delta_1 g &= +78^{\circ}.4T + 11^{\circ}.76T^2 + 0^{\circ}.012T^3, \\ 10^4 \delta_1 \omega &= +\ \ 1^{\circ}.0T + \ \ 0^{\circ}.15T^2. \end{aligned}$$

It follows that the implicit values of the corrections are

$$\begin{aligned} 10^4 \delta g &= -\ \ 78^{\circ}.4T + 15^{\circ}.24T^2 + 0^{\circ}.015T^3, \\ 10^4 \delta\omega &= -191^{\circ}.0T - 31^{\circ}.15T^2 - 0^{\circ}.03\ T^3. \end{aligned}$$

Reducing to seconds of arc

$$\begin{aligned} \delta g &= -28''.22T + \ \ 5''.486T^2 + 0''.0054T^3, \\ \delta\omega &= -68''.76T - 11''.214T^2 - 0''.0108T^3, \\ \delta(g+\omega) &= -96''.98T - \ \ 5''.728T^2 - 0''.0054T^3. \end{aligned}$$

The next question of interest is what corrections of the mean longitude, perigee, and node these imply. We have already found from $\Delta\tau$

$$\delta\lambda = -26''T - 3''.9T^2 - 0''.0039T^3.$$

The argument g being that for the equation of the center is virtually $\lambda - \pi$. Hence

$$\delta\pi = \delta\lambda - \delta g.$$

The virtual longitude of the node is determined by the mean argument of latitude, $g+\omega$, through the condition

$$g + \omega = \lambda - \Omega.$$

Hence, for the virtual correction of the node

$$\delta\Omega = \delta\lambda - \delta(g+\omega) = \delta\pi - \delta\omega.$$

We thus have, for the perigee and node,

$$\begin{aligned} \delta\pi &= +\ \ 2''.22T - 9''.39T^2 - 0''.0093T^3, \\ \delta\Omega &= +70''.98T + 1''.82T^2 + 0''.0015T^3. \end{aligned}$$

These are the corrections which in Oppolzer's Canon der Finsternisse are implicitly applied to obtain the basis of the tables already quoted. To reduce them to the provisional basis of the present work they are equivalent to

$$\text{Newcomb} - \text{Opp. Can.:}\ \begin{aligned} \delta g &= +\ \ 1''.65T - 10''.449T^2 - 0''.0048T^3, \\ \delta\pi &= -\ \ 2''.2\ T + \ \ 9''.75\ T^2 + 0''.003\ T^3, \\ \delta\Omega &= -71''.0\ T - \ \ 2''.00\ T^2 - 0''.000\ T^3. \end{aligned}$$

Ginzel's Empirical Corrections.

63. In his work (Spezieller Kanon der Finsternisse, p. 5), Ginzel gives a system of corrections with which he replaces those of Oppolzer. Changing the notation and form to that of the present work, they are:

$$10^4\Delta\tau = -1^d.92\mathrm{T} + 0^d.247\mathrm{T}^2 + 0^d.00025\mathrm{T}^3.$$

This gives for the corresponding correction to the difference of mean longitude of the moon and sun

$$\Delta\lambda - \Delta L = 8''.43\mathrm{T} - 1''.084\mathrm{T}^2 - 0.0011\mathrm{T}^3.$$

He also uses

$$10^4\Delta P = 10^4\Delta Q = -76^\circ.9\mathrm{T} + 0^\circ.49\mathrm{T}^2 + 0^\circ.00049\mathrm{T}^3,$$
$$10^4\Delta \mathrm{I} = +\ 240^\circ\mathrm{T} + 5^\circ.2\mathrm{T}^2\ + 0^\circ.0052\ \mathrm{T}^3.$$

His values of $\Delta L'$ and ΔIII need not be used.

From $\Delta\tau$ we have

$$10^4\,\delta_1 g = -\ \ 25^\circ.08\mathrm{T} + 3^\circ.227\mathrm{T}^2 + 0^\circ.00327\mathrm{T}^3,$$
$$10^4\Delta g = +216^\circ.00\mathrm{T} + 4^\circ.680\mathrm{T}^2 + 0^\circ.00468\mathrm{T}^3,$$
$$10^4\ \delta g = +241^\circ.08\mathrm{T} + 1^\circ.453\mathrm{T}^2 + 0^\circ.00141\mathrm{T}^3,$$
$$\delta g = +\ \ 86''.79\mathrm{T} + 0''.523\mathrm{T}^2 + 0''.00051\mathrm{T}^3.$$

This gives

$$\Delta\pi = -78''.4\mathrm{T} - 1''.61\mathrm{T}^2 - 0''.0016\mathrm{T}^3.$$

We also have

$$10^4\delta_1\,(g+\omega) = -25^\circ.4\mathrm{T} + 3^\circ.26\mathrm{T}^2 + 0^\circ.0033\mathrm{T}^3.$$

Subtracting this from $\Delta P = \Delta(g+\omega)$, after multiplying ΔP by 0.9, leaves

$$10^4\delta\,(g+\omega) = -43^\circ.8\mathrm{T} - 2^\circ.82\mathrm{T}^2 - 0^\circ.0029\mathrm{T}^3,$$
$$\delta\,(g+\omega) = -15''.8\mathrm{T} - 1''.02\mathrm{T}^2 -- 0''.0010\mathrm{T}^3.$$

Whence, subtracting δg

$$10^4\delta\omega = -284^\circ.9\mathrm{T} - 4^\circ.27\mathrm{T}^2 - 0^\circ.0043\mathrm{T}^3,$$
$$\delta\omega = -102''.6\mathrm{T} - 1''.54\mathrm{T}^2 - 0''.0015\mathrm{T}^3,$$
$$\delta\text{☊} = +\ \ 24''.2\mathrm{T} - 0''.07\mathrm{T}^2 -- 0''.0001\mathrm{T}^3.$$

For the differences, Ginzel–Oppolzer, we have

$$\delta\text{☊} = -46''.8\mathrm{T} - 1''.89\mathrm{T}^2 - 0''.0016\mathrm{T}^3,$$
$$10^4\Delta\tau = -\ \ 7^d.9\mathrm{T} - 0^d.65\mathrm{T}^2 - 0^d.0006\mathrm{T}^3.$$

SECTION III.—COMPUTATION OF ECLIPSES FROM OPPOLZER'S TABLES.

64. The computation of the principal circumstances of eclipses at any period of history can be so easily made by means of Oppolzer's tables with the application of the preceding corrections that it seems desirable to outline the best method of doing this. We begin by recalling to mind the basis of the theory of eclipses. This is a system of coordinates the planes of which pass through the center of the earth as the origin. The fundamental plane of $x\,y$ is perpendicular to the shadow axis. The axis of z is therefore parallel to the shadow axis, but only an approximate value of it is ever necessary. On the fundamental plane two systems of rectangular axes may be taken. In one, the axis of the equatorial system is the intersection of the equator with the plane. In the ecliptic system this axis is the intersection of the ecliptic with the plane. The first is the Besselian, the second the Hansenian system. We shall put

x_2, y_2, the coordinates of the shadow axis in the ecliptic system;
x, y, the coordinates in the Besselian system;
h, the angle between the axes of x in the two systems.

We now show how we may pass from the elements of the eclipse as found from Oppolzer's tables to the coordinates just defined. These elements are the following:

T, the moment of true conjunction of the sun and moon in longitude which we suppose expressed in Greenwich mean time;

L', the true longitude of the sun at this moment;

E, the equation of time, in the sense mean time = true time + E;

ϵ, the obliquity of the ecliptic;

P, the moon's argument of latitude at the time;

Q, p, q, auxiliary quantities which need not be geometrically defined, of which the first differs little from P, while p differs little from $\sin i \div \sin \pi$, and q differs little from $\sin i$, i being the inclination of the moon's orbit;

$\Delta L'$, the hourly motion of the coordinate x_2 of the shadow axis along the fundamental plane.

When we seek the limits of the shadow of the penumbra two additional quantities are necessary, namely—

u, the radius of the umbra on the fundamental plane;

f, the angle which the element of the shadow cone makes with the shadow axis.

There will, of course, be two values of f as well as of u, the one corresponding to the penumbra, the other to the umbra.

These elements are computed from Oppolzer's tables and corrected by the formulæ already given.

The ecliptical coordinates of the shadow axis at the time T in terms of the Oppolzer elements are

$$x_2^{(0)} = 0, \quad y_2^{(0)} = p \sin P. \tag{1}$$

The hourly motions of these coordinates, which we regard as constant, are

$$x_2' = \Delta L',$$
$$y_2' = q \cos Q.$$

Their values at any time $T+t$ are

$$x_2 = x_2' t,$$
$$y_2 = y_2^{(0)} + y_2' t.$$

The method now proposed differs from that of Oppolzer in that these ecliptical coordinates are at once transformed to the Besselian system, which is used in the rest of the computation. For this transformation we need the sun's declination and the angle between the two systems of coordinate axes on the fundamental plane. These are computed by the formulæ

T. h = tan ε cos L, [illegible]
[illegible]

$$\left.\begin{aligned} \cos d \sin h &= \sin \epsilon \cos L', \\ \cos d \cos h &= \cos \epsilon, \\ \sin d &= \sin \epsilon \sin L'. \end{aligned}\right\} \tag{2}$$

If the time of the special phase to be computed differs much from T, it may be well to correct L', the sun's longitude, for the motion during the interval. The effect of this correction will, however, always be small.

In strictness the angle d should be the declination of the shadow axis and not of the sun itself, but as the two are coincident at the total phase, which is the one principally considered, and differ very little in any case, we may use the declination of the sun for d throughout. The coordinates of the shadow axis are now reduced to those of the equatorial system by the equations

$$\left.\begin{aligned} x &= x_2 \cos h - y_2 \sin h, \\ y &= x_2 \sin h + y_2 \cos h. \end{aligned}\right\} \tag{3}$$

The hourly motions may be found by using the numerical values of x_2' and y_2' in these equations. A familiar form of computation is the following:

$$\left.\begin{array}{ll} m\sin\mathrm{M}=x_2, & n\sin\mathrm{N}=x_2', \\ m\cos\mathrm{M}=y_2, & n\cos\mathrm{N}=y_2', \\ x=m\sin(\mathrm{M}-h), & x'=n\sin(\mathrm{N}-h), \\ y=m\cos(\mathrm{M}-h), & y'=n\cos(\mathrm{N}-h). \end{array}\right\} \qquad (4)$$

When, as will nearly always be the case in historical eclipses, we wish to find the circumstances of the eclipse, especially the magnitude of the greatest phase at a given place, our method of proceeding is this: we choose a moment τ expressed in Greenwich mean time as near as convenient to the moment of maximum phase at the place. The preceding computation of the coordinates may advantageously be made for this moment. For this moment we find the local west hour angle of the shadow axis by the equation

$$\mu'=\tau\times 15^\circ-E+\lambda, \qquad (5)$$

λ being the east longitude of the place from Greenwich. The coordinates ξ and η of the place of observation, together with their hourly motions, are found from the equations

$$\left.\begin{array}{l} \xi=\rho\cos\varphi'\sin\mu', \\ \eta=\rho\sin\varphi'\cos d-\rho\cos\varphi'\sin d\cos\mu', \\ \xi'=[9.4192]\,\rho\cos\varphi'\cos\mu', \\ \eta'=[9.4192]\,\xi\sin d, \end{array}\right\} \qquad (6)$$

where ρ and φ' are the radius of the earth and the geocentric latitude of the place.

We assume that the moment τ is so near the time of greatest phase that the hourly motions ξ' and η' may be regarded as constant during the interval. The least distance of the shadow axis from the place of observation, which we call $\varDelta$, is then given by the computation

$$\left.\begin{array}{ll} X=x-\xi, & X'=x'-\xi', \\ Y=y-\eta, & Y'=y'-\eta', \\ \multicolumn{2}{c}{\varDelta=\dfrac{X'Y-XY'}{\sqrt{X'^2+Y'^2}}} \end{array}\right\} \qquad (7)$$

Here, of course, X and Y are the coordinates of the shadow axis relative to the point of observation.

The following form of computation may be used with advantage, especially as the values of s and S are used in computing the differential coefficients:

$$\left.\begin{array}{l} c\sin\mathrm{C}=Y, \\ c\cos\mathrm{C}=X, \\ s\sin\mathrm{S}=Y', \\ s\cos\mathrm{S}=X', \\ \varDelta=c\sin(\mathrm{C}-\mathrm{S}). \end{array}\right\} \qquad (8)$$

A positive value of $\varDelta$ indicates that the shadow axis passes north of the place, and a negative value, that it passes to the south.

65. We have next to determine the displacement by a small change in the elements. Practically, it will suffice to determine the displacement in a direction parallel on the fundamental plane, which will be equal to $\delta\varDelta$. Now

$$\delta\varDelta=\frac{d\varDelta}{dX}\delta X+\frac{d\varDelta}{dY}\delta Y=-\sin\mathrm{S}\,\delta X+\cos\mathrm{S}\,\delta Y. \qquad (9)$$

From the equations (3) we find

$$\left.\begin{aligned}\delta x&=\cos h\,\delta x_2-\sin h\,\delta y_2,\\ \delta y&=\sin h\,\delta x_2+\cos h\,\delta y_2.\end{aligned}\right\}\qquad(10)$$

The expressions for x_2 and y_2 in terms of the lunar and solar coordinates at a fixed moment are

$$\left.\begin{aligned}x_2&=\frac{\sin(v-L')}{\sin(\pi-\pi')},\\ y_2&=\frac{\sin\beta}{\sin(\pi-\pi')}=\frac{\sin i\,\sin(v-\Omega)}{\sin(\pi-\pi')},\end{aligned}\right\}\qquad(11)$$

where i is the inclination of the moon's orbit, and π and π' the parallaxes of the moon and sun, respectively.

In our present problem approximate values of the increments will suffice, so that we may put $\cos(v-\Omega)$ equal to ± 1 according to the node at which the eclipse occurs, and $\cos(v-L')$ equal to ± 1 according to whether it is a solar or a lunar eclipse. We may also take for v indifferently the longitude in orbit of the moon or its ecliptic longitude. Thus we may use for a solar eclipse

$$\left.\begin{aligned}\delta x_2&=\frac{\delta v-\delta L'}{\sin(\pi-\pi')},\\ \delta y_2&=\pm\frac{\sin i}{\sin(\pi-\pi')}(\delta v-\delta\Omega).\end{aligned}\right\}\qquad(12)$$

The substitution of these values in (10) gives δx and δy.

Since Δ is a function of $x-\xi$ and $y-\eta$ we have in rigor to subtract $\delta\xi$ and $\delta\eta$ from δx and δy. But we see from a comparison of (6) and (12) that $\delta\xi$ and $\delta\eta$ are less than δx and δy in the ratio $\sin\pi : 1$; we may therefore drop them entirely. We may then use instead of (10)

$$\begin{aligned}\sin(\pi-\pi')\delta X&=\cos h\,(\delta v-\delta L')\mp\sin h\,\sin i\,(\delta v-\delta\Omega),\\ \sin(\pi-\pi')\delta Y&=\sin h\,(\delta v-\delta L')\pm\cos h\,\sin i\,(\delta v-\delta\Omega).\end{aligned}$$

By substituting in (9) we see that the partial derivatives of Δ as to v, L' and Ω may be written

$$\left.\begin{aligned}\frac{d\Delta}{dv}&=\frac{\sin(h-S)}{\sin(\pi-\pi')}\pm\frac{\cos(h-S)}{\sin(\pi-\pi')}\sin i,\\ \frac{d\Delta}{dL'}&=-\frac{\sin(h-S)}{\sin(\pi-\pi')},\\ \frac{d\Delta}{d\Omega}&=\mp\frac{\cos(h-S)}{\sin(\pi-\pi')}\sin i;\end{aligned}\right\}\qquad(13)$$

the upper sign being used for an eclipse near the ascending node and the lower sign for one near the descending node.

To use the corrections of the mean longitudes of the sun and moon, as we should in theory, we multiply $\frac{d\Delta}{dL'}$ by $1+0.034\cos g'$, and $\frac{d\Delta}{dv}$ by $\frac{dv}{d\lambda}$, for which last we may put, in the case of a solar eclipse

$$\frac{dv}{d\lambda}=1.019+0.131\cos g.\qquad(14)$$

The increment of Δ in terms of increments to the moon's and sun's mean longitude, and Ω, the node, will then be

$$\delta\Delta=\frac{d\Delta}{dv}\frac{dv}{d\lambda}\delta\lambda+(1+0.034\cos g')\frac{d\Delta}{dL'}\delta L+\frac{d\Delta}{d\Omega}\delta\Omega,$$

the factors having the values given in (13) and (14).

[illegible] x_2 [illegible] $x_2 = 0$ at [illegible]
$v =$ [illegible] $-L'$ [illegible] equals $-$ [illegible]. The formula should be $\frac{\sin(\text{True Long.} - \text{True Long.}\ \odot)}{\sin(\pi-\pi')}$
[illegible]

Limits of the Umbra.

66. To determine from observation the position of a geographical point relative to the axis of the shadow at the moment of nearest approach, it is generally necessary to make use of the duration of the total phase at some point near the limit of the penumbra. We have therefore to determine the radius of the umbra at the place. For this we require angle f, which the elements of the umbral cone make with the axes, and in connection therewith the radius of the umbra on the fundamental plane. This branch of the theory of the eclipse is so familiar that no detailed development of the theory is necessary. The theory, so far as we have to make use of it, is rendered all the simpler from the fact that what we require is not the geographical limit of the shadow path on the earth's surface, but only the position of the place relative to the umbral cone at the moment of the nearest approach.

The angle f differs but little from the apparent semidiameter, s', of the sun. For the mean value of s' we use that which I have adopted in my Tables of the Sun, in which the effect of irradiation is subducted. This value is

$$s'_0 = 959''.63.$$

The sun's apparent semidiameter is, therefore,

$$s' = \frac{a'}{r'} \times 959''.63.$$

For the moon's constant of semidiameter I have found

$$s_0 = 932''.58.$$

Taking 8″.80 as the constant of solar parallax, the well known formula for the angle f may be reduced to the following approximate form:

Put f_1 for the umbral angle, and f_2 for the penumbral angle, although we shall scarcely have occasion to use the latter in our present work. Dropping terms of the order e'^2 we shall have:

$$f_1 = 957''.23(1.0026 + e' \cos g'),$$
$$f_2 = 962''.03(1.0026 + e' \cos g'),$$

where e' is the eccentricity of the earth's orbit and g' the sun's mean anomaly. If a more precise value is desirable, it may be found by the equations

$$\text{Umbra} \qquad f_1 = \frac{957''.23}{r' - .00258},$$

$$\text{Penumbra} \qquad f_2 = \frac{962''.03}{r' - .00258},$$

where r' is the sun's radius vector expressed in the usual way.

In Oppolzer's tables are given the formulæ for the radius on the fundamental plane, while the numerical value of the penumbral radius is tabulated for each eclipse in his Canon. But the enlarged semidiameters of the sun and moon, as affected by irradiation, have evidently been used in these formulæ.

The rigorous formula for the radius of the umbra on the fundamental plane is

$$u = k \sec f_1 - z \tan f_1,$$

where z is the perpendicular distance of the moon's center from the fundamental plane, expressed in terms of the earth's equatorial radius, while k is the linear radius of the moon. If the exact value of z is wanted, which it is only in exceptional cases, it may be found with sufficient precision by the formula

$$z=\frac{\cos G}{\sin \pi},$$

G being the geocentric angular distance of the centers of the sun and moon at the moment of the phase under consideration.

For our purpose the umbral radius required is that upon a plane passing through the place, parallel to the fundamental plane. The distance of these two planes is the coordinate ζ corresponding to the formulæ (6) of which the value is

$$\zeta=\rho \sin \varphi' \sin d+\rho \cos \varphi' \cos d \cos \mu';$$

the required umbral radius is then

$$u_1=u+\zeta \tan f_1.$$

Should the penumbral radius also be required, this expression is

$$u_2=u'-\zeta \tan f_2.$$

The distance of the place from the margin of the shadow cone at the moment of greatest obscuration is then equal to

$$u_1-\Delta.$$

If this difference comes out negative, it shows that according to the tables the eclipse was not entirely total at the place.

Ancient Eclipses—Numerical Results.

67. The results of the whole computation are tabulated as follows: T, L', etc., are the elements from the author's theory, in Oppolzer's notation. Δ is given in units of the fourth place of decimals of the earth's equatorial radius. Each Δ is followed by the increment which it would receive from an increment of λ, ☊, and L', all, for convenience, expressed in minutes of arc.

Elements of Seven Ancient Eclipses.

T			L'	E	P	Q	log p	log q	log ΔL
			°	°	°	°			
−1062	July	30.7548	116.332	+0.11	177.858	175.90	0.7005	8.7490	9.7528
− 762	June	4.8691	74.585	−2.08	176.547	174.74	0.6988	8.7509	9.7555
− 647	Apr.	5.8765	8.925	+0.75	171.597	172.14	0.6909	8.7594	9.7638
− 430	Aug.	3.1327	124.487	+0.52	170.577	172.95	0.7233	8.7262	9.7277
− 309	Aug.	14.8505	136.573	+0.52	3.736	2.66	0.6929	8.7574	9.7612
− 128	Nov.	20.0565	236.080	−2.79	9.403	11.40	0.6998	8.7490	9.7509
+ 197	June	2.9958	71.068	−1.61	1.702	4.03	0.7245	8.7249	9.7268

Node.	Date.			Minimum distance of shadow-axis.				Radius of shadow.
☋	−1062	July	30	$\Delta=+516$	$-16.2\,\Delta\lambda$	$+15.0\,\Delta$☊	$-0.3\,\Delta L'$	+94
☋	− 762	June	15	+684	−3.3	+14.8	−11.9	+151
☋	− 647	Apr.	6	+567	−25.7	+14.6	+7.7	+178
☋	− 430	Aug.	3	+577	+23.4	+15.3	−38.7	−55
☊	− 309	Aug.	14	−227	−7.9	−14.6	+21.5	+145
☊	− 128	Nov.	20	+018	−20.9	−14.7	+33.6	+15
☊	+ 197	June	3	−436	−14.3	−15.6	+30.0	−6

The preceding eclipses, that of −128 excepted, were discussed by Mr. Cowell. He shows that five of the eclipses in question can all be represented in two ways, either by a change in the secular acceleration of the node, or by a hitherto unsuspected acceleration of the sun's longitude, combined with an equal correction to the moon's secular acceleration.

It will be seen that the preceding equations are confirmatory of Mr. Cowell's results. A diminution of 36′ in the longitude of the node will make all five of the eclipses nearly or quite annular or total, as the case may be. This effect will be brought about by a diminution of about 3″.5 in the secular acceleration of the node.

In the equations it will be seen that the sums of the coefficients of the increments are nearly evanescent. It follows that the representation of the eclipses will remain nearly unchanged when we assign arbitrary equal increments to the longitudes of the moon, the sun, and the node. Hence, instead of a diminution of 3″.5 in the nodal acceleration, we may assign an increment of 3″.5 to the accelerations of the sun and moon. All this is quite accordant with Cowell's conclusions.

On the other hand, Cowell's corrections make both the eclipse of −309 and that of −128 only partial in the Hellespont. We have therefore to set against the evidence of the five the contrary evidence afforded by the eclipse of −128 that the elements admit of no correction.

It may also be remarked that an increase of 1″ in the secular acceleration of the mean longitude, coupled with a diminution of 1″ in that of the node, would suffice to make the eclipses of −1062 and −647 total, without throwing that of −128 quite away from the Hellespont. But this change in Δ^2☊ is outside the limit of theoretical uncertainty, and in $\Delta^2\lambda$ is difficult to admit.

The question whether the remarkable coincidence among the five eclipses affords probable evidence that either set of corrections to the elements is real is one on which opinions will doubtless differ. It must certainly be admitted that either correction seems extremely improbable. In the case of the node, gravitational theory admits of no appreciable correction to the adopted secular acceleration. That any other cause than gravitation changes the motion of the node is rendered improbable by the close agreement between the actual motion and the theoretical motion derived by Brown.

Equally difficult of explanation on any theory is a secular acceleration of the earth's orbital motion. Moreover, while modern observations, so far as I have discussed them, do not exclude the possibility of such an acceleration, they do render it improbable.

The other branch of the question is, whether a chance coincidence in five cases out of six can be regarded as conclusive. The evidence in favor of the actual centrality at the several places of record of the eclipses, as the accounts are cited by Mr. Cowell, seems to me rather weak. It is certain that the eclipses were central within a few hundred miles of the several points, but, in the absence of any specific statement of the place, I see nothing stronger than a greater or less presumption of centrality at the supposed places.

The eclipse of the list in which the question of the phase is most perplexing is that of −430, described by Thucydides, and also mentioned by Cicero and Valerius Maximus, as seen at Athens. Both of these accounts are weak from proving too much, namely, a total eclipse. If there could be any question whether the eclipse was annular or total, the combined weight of the two accounts would lead us to regard totality at Athens as practically certain, because no other phase could have been one of darkness, caused alarm among the citizens, or made the stars visible. We must therefore make a large allowance for exaggeration; and the question is whether this allowance can be much smaller for an annular eclipse than for the partial eclipse which is computed from the tables. The most exact basis for a comparison is afforded by comparing the fraction of the sun's disk which must have remained uncovered in the two hypothetical cases. I find that if the eclipse was annular at Athens, the breadth of the annulus was about 18″. If it were partial, a rough computation shows that the area of the sun's disk uncovered was about four times that of the annulus—

possibly nearly five times. At first sight this difference might seem important, but a little consideration may lead us to minimize this importance. The difference in the intensity of daylight under a cloudy sky may well be much greater than this without being striking. The light of the sky a very few minutes after sunset is less than it was during either of the hypothetical phases. Those who have observed total eclipses of the sun know how little striking is the apparent diminution in the intensity of daylight up to within a few minutes of the total phase, and how suddenly the first ray of the reappearing sun illumines the sky and blots out the stars. Computation shows that Venus was very favorably situated for observation during the eclipse of —430, and it may well be doubted whether any other star or planet could have been visible, even if the phase were annular. It is also to be considered that the ratio of the illuminations of the sky in the two cases is less than that of the uncovered sun. Altogether, we may make an ample allowance for exaggeration and misapprehension without overstepping the bounds of reasonable probability.

CHAPTER XIII.

CONCLUDING REMARKS.

The original plan of the present work contemplated a comparison of the observed fluctuations with those of the earth's rotation, assuming the latter to be corrected by observations of Jupiter's satellites and by transits of Mercury. The author made a fairly complete list of the less known observations on eclipses of Jupiter's first satellite from the time of the early Paris astronomers, Picard, etc., until nearly the present. The idea of the comparison is this:

Making abstraction of possible limitations imposed by the laws of motion, the observed fluctuations in the moon's mean motion may be equally due to actual changes in that motion or to changes in the earth's rotation leading to errors in our measurement of time. Which alternative is to be chosen can be determined only by having some independent method of detecting errors in our measure of time. Only two tests on this point are available, one consists in the observed transits of Mercury, the other in observations of Jupiter's satellites.

In the Researches of 1878 will be found a tabular exhibit of the corrections to the measure of time which would account for the observed fluctuations up to 1877. But this is imperfect as regards the period 1750–1870, because the investigation was not complete for that interval. It was there assumed that Hansen's tables represented observations of the moon during the century in question. The results of the present work show that this is far from being the case. The author's discussion of all observed transits of Mercury up to 1881 is found in the first volume of Astronomical Papers prepared for the use of the American Ephemeris. A special effort was made to decide the question whether the observed fluctuations in the moon's motion could be attributed to changes in the earth's rotation, but the question was left in doubt, the inequalities derived from transits of Mercury being only one authority of those necessary to explain the phenomena. It followed that while it was still possible that the inequalities were partly due to the cause in question they were mainly unreal.

About May, 1896, the subject was again taken up in a paper published in the Comptes Rendus (Tome 122, p. 1235). The observations of the transit of 1891 had been made and published in the meantime, and of course would add greatly to the result. The comparison of the observed and theoretical times of the phases was made with the author's new tables of Mercury and the sun, which had just been brought to completion in manuscript. Only November transits were used, the weight of the May transits being very small. Since then the transit of November 13, 1907, has been observed.

The general outcome of these comparisons at the present time is that the curious anomaly of fluctuations, one-third of the magnitude of those required to explain the seeming lunar inequalities, have disappeared. In fact, the fluctuations in the earth's axial rotation, as indicated by transits of Mercury, are no greater than the possible errors of the results. The conclusion to be drawn from all the observed transits of Mercury up to date is that the earth's axial rotation is nearly invariable and can be affected by no inequalities exceeding a small fraction of those needed to explain the apparent fluctuations in the moon's mean motion.

It will still be of interest to test the question by the observations of Jupiter's satellites. The author hopes that this will speedily be done with the aid of the material which he has gathered for the purpose, and which is in good shape for use.

An elaborate discussion of the corrections for reducing eclipses of Jupiter's satellites has been made by Professor Glasenapp. If the proposed new discussion is to be exhaustive, these corrections should be taken account of. But for the practical purpose of the work little will be gained by doing so because the unavoidable probable errors of the observations are of a nature that can be eliminated only by multiplying the number of observations and not by minute corrections to them. A necessary supplement to the present work as published is my own work on solar eclipses. Only two determinations are to be sought for from this source. One is the longitude of the moon's node, which ought to be determinable with great precision from the observed path of the moon's shadow. The other is the sun's longitude relative to the stars using the moon as an intermediary.

The lack of modern determinations of the shadow path in total solar eclipses is very curious, especially as the author has made various attempts to either carry out such determinations himself or to have them done by others. The first author who seems to have been alive to the interest and importance of this determination was Halley, who, before the eclipse of 1715, May 3, organized a special set of observations to determine the limits of totality on either side. His observations are found in the Philosophical Transactions, and are very fully described by the writer in his Researches of 1878.

In view of the interest and importance of the subject it is a curious illustration of the unsystematic way in which astronomical work is organized that nearly 100 years elapsed before anyone else attempted to repeat Halley's enterprise. Nathaniel Bowditch, the celebrated translator of the Mecanique Celeste, essayed a similar set of determinations for the total eclipse of 1806. The data which he derived are fully published in the Memoirs of the American Academy of Arts and Sciences. The author has undertaken, as a part of the present work, to determine the shadow path from these data. But he found himself unable to derive any consistent results for either limit of the shadow. How the discrepancies between the reports of the observers are to be explained it is hard to see. The observations look as good on every phase as those made by Halley's observers a century ago. It is barely possible that the author has himself overlooked some point in connection with the stations or made some error in his discussion. But he must leave it to others to ascertain whether such is the case.

The writer himself assayed a similar set of determinations during the total eclipse of 1869. These were entirely successful, and he believes that the limits of the shadow path can be determined from the reports in the official observations of the eclipse with very great precision. But he has not had time to derive the conclusions.

A similar effort was made during the total eclipse of 1878, observations of which will be found in the author's reports of this eclipse. But the uncertainty of the geographical position of many of the stations necessitated a continual postponement of the final discussion until it became too late to undertake it.

When the American photoheliograph for photographing the transits of Venus was designed a greatly improved system of determining the center of the shadow path became available. By photographs of the partial phase on each side of totality as made with this instrument it would have been easy to locate the path of the center of the axis of the shadow. But it is singular that every effort which he made to apply the instrument was frustrated in one way or another. In 1878 his own photographs were a total failure, through the carelessness of the official authority who prepared the instructions for taking them. The result was that they were too faint to admit of measurement. It is needless to catalogue the several eclipses which have since occurred and to state in detail how each attempt to use the photoheliograph for the purpose in question was a failure. This is all the more to be regretted because in reality a total eclipse is not necessary for the determination. The fact is that photographs of the annulus taken on each side of the center are not only as good as but much better than those pertaining to the total phase.

The author earnestly hopes that the science of geometric astronomy will not continue in the backward state implied by these failures.

The enigmatical character of the inequalities brought out in the present work has been shown in the author's address to the International Association of Mathematicians at Rome in 1908. It seems almost impossible to construct any explanation of the phenomenon without in some way setting aside the fundamental laws of dynamics. Tidal retardation will not account for the fluctuations unless modified in some way not now apparent. In fact, this retardation will affect the actual motion of the moon as well as the length of the day, and what forms the basis of the paradox itself, the difference of the earth's rotation and the moon's fluctuation, and not a sum which would result from retardation.

The author had intended to reinvestigate the whole question of tidal retardation taking into account the tidal action of the three bodies, the sun, moon, and earth. A necessary part of this work would be an expression of the dynamical action of the sun and moon on the tidal wave in true terms of the modification in the form of the wave produced by friction. This is a chapter on the subject which the author believes has remained uninvestigated even by Darwin. These hints are dropped merely with the hope that they may be found useful to the future investigator who shall inquire into the theory.

The most unsatisfactory feature of the conclusion of the entire work as carried through by the author is that, until the matter is cleared up, it will be impossible to predict the moon's longitude with the precision required for astronomical purposes. We shall be obliged to correct the moon's mean longitude from time to time, perhaps at intervals of 10 or 20 years, from observations.

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